

*Shaping Suburbia: Retrofitting Neighborhoods  
to Form a More Holistic, Sustainable Suburb*

**An Honors Thesis (LA 404)**

**by**

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A handwritten signature in black ink, appearing to read 'Meg Calkins', with a long horizontal flourish extending to the left.

**Ball State University  
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## ABSTRACT

With this project I attempted to counteract the wasteful use of resources and inefficient, automobile-dependent transportation network of a conventional suburban area just outside Evansville, Indiana. My research explored methods for incorporating multi-modal transportation, sustainable infrastructure, and the preservation of natural features into the site's redevelopment. The resulting framework plan, master plan, and site design solutions express the function and aesthetics of a more healthy and unique suburban community that maintains and enhances the existing homes and commercial buildings. With this project I tried to suggest how this and other suburban areas might become more beautiful, more walkable and bikeable, and more sustainable overall.



## ACKNOWLEDGEMENTS

This work was produced in collaboration with several people who generously shared their knowledge and time.

Many thanks to Karan Barnhill, Neal Bogan, Cris Cottom, Norma Duckworth, Laura Howell, John Stoll, and Kim Townsend for educating me about Evansville and my site.

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Finally, I am privileged to have consistent support from the kindest, most caring parents and one extremely cool sister. Thank you always.

## AUTHOR'S STATEMENT

I analyzed problems common to many suburbs within the context of a site just outside Evansville, IN. My research explored how the auto dependence prevalent in suburbia requires much fuel and infrastructure; that dependence compels the pollution of air and water and encourages less healthy lifestyles as people usually drive rather than walk. I aimed to address these and other problems by researching different transportation options, such as how to promote walking and bicycling through sidewalks and trails. I also studied how to increase recreational opportunities and preserve natural features and resources. This research led to design work that details the function and aesthetics of transformed suburban infrastructure.

My work has important implications for how people see and react to the suburbs, as I did not follow the common design model for improving these areas. Most contemporary projects include much infill, or new construction of residences and commercial areas. Rather than design an entirely new neighborhood, I tried to pinpoint the small, subtle changes that may be made in established neighborhoods. I identified solutions on different scales — from a 1,200 acre site to a 60 acre focus area to individual sites under an acre in size. My work explored where off-road paths might be placed within a large area to where herbs and vegetables might best be grown in one's yard or in a commercial plaza. Many of my design solutions might be implemented by a home or business owner, making this project a valuable resource for its accessibility to individuals and neighborhood groups with small budgets.

Through working on this thesis I have become more practiced in formal research methods and in communicating my work in digital format, through Adobe Suite products for instance. My ability to work at different scales and analyze multiple physical, social, and economic facets of a place has been heightened as well, and I am a better designer as a result.

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## INTRODUCTION

*"Suburbia is where the developer bulldozes out the trees, then names the streets after them."*

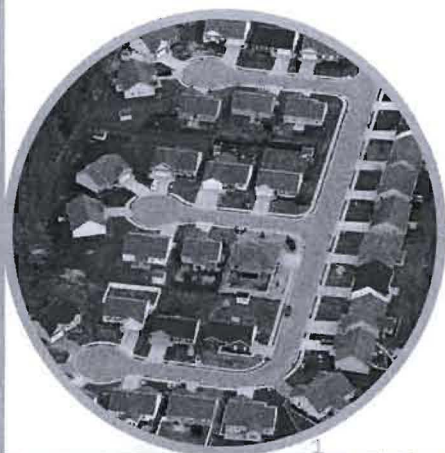
—William ("Bill") Vaughan, American columnist and author

Planners, designers, community leaders, and others increasingly view suburbia as a wasteful and unsustainable means of land and resource consumption. Agricultural and natural lands disappear as the suburbs expand away from cities. Asphalt dominates these automobile dependent areas in which suburbanites drive 31% more and consume much higher amounts of gasoline than urban dwellers (Kahn, 571). Commercial areas and residential neighborhoods appear much the same as other suburban commercial and residential areas (Bohl, 10). Too many suburban developments possess an anywhere, or nowhere, appearance that lacks beauty, walkability, sustainability, and community identity.

To combat these trends, I chose to retrofit a suburban area just outside Evansville, Indiana. The selected site has grown much in the last decade, but new developments have not helped form a great place in which to live. The site currently contains a number of neighborhoods with entrances only on Oak Hill Road, a busy arterial. Residents must drive between destinations, and few recreational spaces exist for public use.

Using this site I explored methods for shaping a more interesting and healthy suburb through the incorporation of walkable streets and recreational opportunities around established neighborhoods and commercial businesses. I also attempted to protect ecological systems and water resources. Thus, with this project I sought to learn about and provide an example for how established suburban areas might be shaped into more sustainable communities that support healthy environments and healthy, happy people.





# PROJECT BACKGROUND

## PROBLEM STATEMENT

I used research to explore ways to transform suburban neighborhoods and a commercial area into a more sustainable, holistic, and beautiful community. Opportunities for multi-modal transportation, recreation, and preservation of natural features were included in that research and addressed these basic questions:

- How can the existing transportation system be improved to offer diverse pedestrian and bicycle, or multi-modal, options?
- How can recreational sites and opportunities be integrated into the existing community to serve all ages and abilities?
- How can existing natural features, such as Pigeon Creek and its surrounding woodlands, be preserved and protected?

## PROJECT SIGNIFICANCE

I sought solutions for the problems common to many suburbs within the context of an area just outside Evansville, Indiana. Unsustainable land consumption is the most significant of these issues as the site's prevalent, low-density developments require extensive infrastructure and create automobile dependence. Devotion to autos consumes much fuel and increases surface runoff and emissions of water and air pollutants (Frumkin, et al., 65). Vehicles and roads help destroy natural features, such as the site's Pigeon Creek (Townsend), and they diminish agricultural land. Between 2002 and 2007, in fact, 10,108 acres of crop and woodland were developed in Vanderburgh County, where the site is located (National Agricultural Statistics Service, 11). Such land consumption and auto dependence is unsustainable, and I aimed to redirect development practices.

My research and design explored ways to integrate opportunities for walking and bicycling into the site, encouraging physical fitness and preventing illness (Frumkin et al., 94). After



bicycle construction and maintenance, walking and bicycling are also non-polluting (Comanoff & Roelofs, 5). The area currently possesses no trails or recreation areas other than empty, mowed open space; thus, I incorporated off-road paths into the larger site and parks and plazas within the project focus area so people might have safe and attractive spaces in which to travel, recreate, and host events.

Finally, I attempted to protect and enhance the site's ecological systems and natural features, such as Pigeon Creek and its surrounding woodlands. My design required no clearing of forested areas, and I designated space in which native vegetation might grow and provide habitat for wildlife. Integration of sustainable, or low impact, infrastructure further supports ecological system health by managing stormwater. The entire redevelopment would, I hope, encourage people to drive less, exercise more, and participate in a more sustainable, holistic, and unique community.





## REVIEW OF LITERATURE

This information originates from a review of literature addressing the questions posed in the problem statement. Much of this review informed the succeeding design work.

### **Forming a Diverse, Multi-Modal Transportation System**

The site's existing organization requires that people drive between destinations. Such automobile-dependent development leads to increasing obesity rates, decreased sociability, and negative environmental impacts (Farr, 19-25). It also creates a monotonous, asphalt dominated environment that limits transportation options and sensory experiences. Establishing a network of multi-modal roads and off-road paths combats this problem. The network equalizes motor-vehicle, bicycle, and pedestrian transport. It promotes healthier lifestyles, more social interaction, and better environmental management.

A multi-modal network includes roads, paths, and trails that serve a variety of users. Large arterials, such as the site's Oak Hill and Lynch Roads, may be designated as gateway corridors or boulevards and include multiple vehicular lanes separated by wide, planted medians, bicycle lanes, and wide sidewalks. Local roads and smaller neighborhood streets should include at least 5-foot-wide sidewalks, but bicycle lanes might not be necessary (Hall and Porterfield, 90-91; Schmitz et al., 25). These smaller connectors should be narrow to slow traffic and create a more comfortable environment for pedestrians (Girling & Kellett, 14; Schmitz et al., 35). They should also be part of a network where street grids with multiple intersections create high connectivity (Girling & Kellett, 78; Schmitz et al., 35) while a few interspersed cul-de-sacs aid in calming traffic. Pedestrian- and bicycle-only paths might replace some street connections, reducing the need for fuel-consuming driving and increasing opportunities for exercise and recreation (Girling & Kellett, 81).

Forming a more pedestrian- and bicycle-friendly community also involves creating compact neighborhoods and providing a number of service and open space destinations within them. People are more strongly motivated to walk to specific destinations, rather than walking just for recreation (Dill, 74). Creating destinations requires a mix of land uses that includes homes, restaurants and businesses, parks and plazas, and small institutions, such as libraries, in which people may recreate, gather, and socialize (Calthorpe & Fulton, 37). As most people are only willing to walk between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (5-10 minutes) to destinations (Dover & King in Sustainable Urbanism, 128; Girling & Kellett, 146; Schmitz et al., 24-25), commercial services, transit stops, and gathering spaces must be provided to the maximum number of households within those radii.

Additionally, as opposed to conventional suburbs, walkable communities should have certain aesthetic amenities, such as street lighting with shorter heights to serve pedestrians over cars, and a focused use of trees and landscaping to form comfortable street and sidewalk enclosures (Federal Highway Administration, 9-10). Open space and recreational destinations should be accessible by foot and bicycle through streets and off-road trails (Girling & Kellett, 15). By ensuring that people have destinations nearby and non-motorized ways to access them, communities become significantly more pedestrian- and bicycle-friendly.

## Integrating Recreational Sites and Opportunities that Serve All Ages and Abilities

As previously established, the Evansville site currently lacks space for recreation. Only a few spare neighborhood parks exist, some neighborhoods lack sidewalks, and all roads lack bicycle lanes. This does not necessarily deter people from walking and bicycling, but pedestrians often hop into yards when cars pass, and many people explore only their neighborhoods, as crossing large roads to access other neighborhoods is unsafe. Therefore, to provide recreational opportunities for people of all ages and abilities, a network of large and small open spaces must be created and linked by pedestrian- and bicycle-friendly paths and off-road trails. Natural features, such as Pigeon Creek, must also become areas around which people may recreate.

Opportunities for recreation should be provided within a network of interconnected, differently-sized areas that provide many ways for people to exercise or engage in leisure or gathering activities (Girling & Kellett, 15; Hall & Porterfield, 233; Untermann & Lewicki, 189). Some spaces might contain sports fields, and others should be entirely devoted to passive activities, such as picnicking and strolling. Small parks and plazas may provide attractive transitions between different residential and commercial land uses. Neighborhood parks, which might demand only 1/6 an acre, are deemed particularly important as they make recreational space available to the greatest number of people within a 3-5 minute walking distance (Farr, 170; Hall & Porterfield, 232; Schmitz et al., 25). Larger parks and sports fields appear less frequently and people often access them by car.

The linkages between spaces should also provide recreational opportunities. Ways to make roads pedestrian- and bicycle-friendly were discussed in the last section (Forming a Diverse, Multi-Modal Transportation System). Incorporating unpaved trails and paved paths accessible to the disabled creates





additional transportation options. Unpaved trails could be just a few feet wide, and larger pathways could run along linear site features, such as roads and streams. On the site specifically, a paved greenway trail could follow Pigeon Creek and connect to the Pigeon Creek Greenway that exists further west of the area. Trails running through natural areas are highly desirable. They give people the means to observe and appreciate plant and wildlife while also helping connect people between homes and gathering or commercial centers. (Schmitz et al., 25; Untermann & Lewicki, 85)

In fact, natural features and recreational amenities may be used to support community identity (Schmitz et al., 54). Girling and Kellett consider California's Village Homes neighborhood a strong, sustainable community because of its recreational assets. They allude to the community's hierarchical plan of open spaces – from private yards to small neighborhood commons, to pedestrian and bicycle paths and greenways that connect to even larger public open spaces and agricultural landscapes. Within the open space network exists a sustainable stormwater management system important to reducing the built elements' influence on the natural environment. Due to the community's good pedestrian network, surveyed residents know more than twice the number of neighbors than people in surrounding, conventional neighborhoods (7). Residents in the Kentlands, a New Urbanist community in Maryland, also claim to talk more with neighbors than they had in more conventional subdivisions due to socialization opportunities created by paths and gathering spaces (Kim, 51). Establishing a strong recreational network in the site area may connect residents with the site's natural features and provide all people with opportunities for physical activity and socialization.





## Preserving and Protecting Existing Natural Features

The site's most visible natural features are Pigeon Creek and its surrounding woodlands. These elements run directly through the area, weaving in-between neighborhoods and agricultural fields. The woodlands, at least, provide an attractive enclosure along roads and around homes, but trees are often cleared during neighborhood and road construction projects. Pigeon Creek has eroded banks and polluted, muddy water. The site's natural features may be preserved and protected by restricting the spread of development and using sustainable infrastructure to minimize the impacts of suburban growth.

Restricting development involves finding areas where construction has the least impact on wildlife habitat, soil stability, and opportunities for recreation. Landscape architect Ian McHarg designed The Woodlands community in Texas to incorporate forest land according to those characteristics (Forsyth, 175); the Woodlands is popular because of its forested trails and natural aesthetic (260). Similarly, designating areas for protection in Evansville requires much knowledge of the existing site characteristics.

Restricting development specifically around Pigeon Creek requires the designation of a protected riparian zone (Girling & Kellett, 123-124; Kihlsinger, et al. in Farr's Sustainable Urbanism, 120). Riparian zones are strips of land affecting and affected by adjacent water bodies. The strips are transitional areas between aquatic and upland habitats (Fischer & Fisichenich, 1). Healthy riparian buffer strips support a high level of wildlife and vegetation diversity, and they improve water quality by preventing erosion and runoff (Division of Fish and Wildlife, 1-2). Though the appropriate width of riparian zones is ultimately determined by the characteristics of specific sites, 100-foot-wide strips on each side of a water body provide the minimum amount of riparian habitat necessary to support wildlife and protect water quality (Division of Fish and Wildlife, 2; Fischer & Fisichenich, 8;

Scientific and Technical Advisory Committee, 58). Thus, at least 100 feet of woodland should be preserved on each side of Pigeon Creek, and larger widths may be applied upon completion of more in-depth site analysis.

Minimizing the spread of new residential and commercial projects will also help protect natural features. Low-density suburban development, common to the Evansville site, contributes more impervious surface and infrastructure per capita than higher-density, more urban development (Richards in Sustainable Urbanism, 109; Victoria Transport Policy Institute, 3). The roads required in low-density areas disrupt habitats, fragment wildlife populations, and contribute to water and air pollution (Victoria Transport Policy Institute, 8). Therefore, to protect natural features and ecosystems new residential or commercial areas within the site should be denser and require less acreage than what currently exists. Various sources, such as the Congress for the New Urbanism and the Smart Growth Network, recommend densities according to the character a new development is meant to assume. For instance, a commercial area that serves a regional population will be denser than a neighborhood commercial area. Assigning densities for the site will require more extensive knowledge of the site and its surroundings.

A final method for protecting natural features requires the incorporation of environmentally-sensitive, or sustainable, infrastructure into new and old development. Sustainable infrastructure largely includes water management systems that use fewer natural resources and minimize runoff and pollution. Sustainable systems manage rain where it falls, rather than sending rainwater away from the site and into water bodies, such as Pigeon Creek (Richards in Farr's Sustainable Urbanism, 109; Sustainable Sites Initiative, 29). Forestland and other natural vegetative cover are considered part of sustainable infrastructure, as these areas provide plant life which filters runoff pollutants and



prevents erosion (Environmental Protection Agency; Sustainable Sites Initiative, 17-19). Other solutions include building roads that manage their own stormwater through bioswales and permeable pavement. Installing rain gardens, green roofs, and individualized rainwater harvesting devices such as rain barrels also manages stormwater by slowing or preventing the movement of rainwater while vegetation filters out contaminants (Girling and Kellett, 124, 147; Richards in Farr's Sustainable Urbanism, 109). When used together with traditional sewer and retention systems, sustainable infrastructure forms more effective, less wasteful water management systems and could greatly improve the Evansville site.



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# PROJECT REQUIREMENTS

## PROJECT GOALS

I attempted to learn how established suburban neighborhoods might be shaped into more healthy and sustainable communities. Research findings informed plans that encourage multi-modal transportation use, outdoor recreation, and preservation of natural features. Site designs detail the function and aesthetics roads, gathering spaces, and yards. To this end I developed the following goals and objectives:



### **Goal 1: Establish a multi-modal transportation network that connects area residents with recreational opportunities, commercial services, and other neighborhoods.**

- Objective 1: Generate a network of sidewalks, bicycle lanes, and trails that run throughout the community.
- Objective 2: Reinstitute the arterial roads – Oak Hill and Lynch – as attractive, multi-modal gateways into the community.

### **Goal 2: Enhance recreational opportunities in and outside of neighborhoods.**

- Objective 1: Establish new recreational opportunities in neighborhoods through sidewalks, trails around neighborhood lakes, and pocket parks.
- Objective 2: Establish a trail and other opportunities for recreation along Pigeon Creek and through other natural features, such as woodlands.
- Objective 3: Provide community parks that serve all area neighborhoods and residents.

(see Goal 3 next page)

**Goal 3: Preserve natural features and promote sustainable infrastructure development.**

- Objective 1: Protect natural areas and unique environmental features, such as Pigeon Creek, from development and the effects of nearby development.
- Objective 2: Incorporate innovative storm and wastewater management methods and other sustainable infrastructure techniques throughout the area.

## PROJECT CLIENTS/SITE USERS



**Residents:** The residents in the site's many neighborhoods make up the largest client group. However, the exact population of this area is unknown as the site spans across, but does not entirely comprise, two census blocks.

**Visitors:** Additional project clients/site users include any visitors to the residences, commercial area customers, Oaklyn Library users, Pigeon Creek Greenway users, and anyone using the site's sidewalks, bike lanes, and off-road paths.

**Wildlife:** Wildlife, such as raccoons, red fox, red-tailed hawks, and other birds and mammals may also be considered users, as I have prioritized the protection of ecological systems and habitats.



**City and County Administrators:** Evansville's mayor, Jonathan Weinzapfel, its urban and regional planners, and city and county environmental service workers may be considered project clients. Evansville and Vanderburgh County administrators may benefit from my work as they are looking to make the city and county more sustainable.



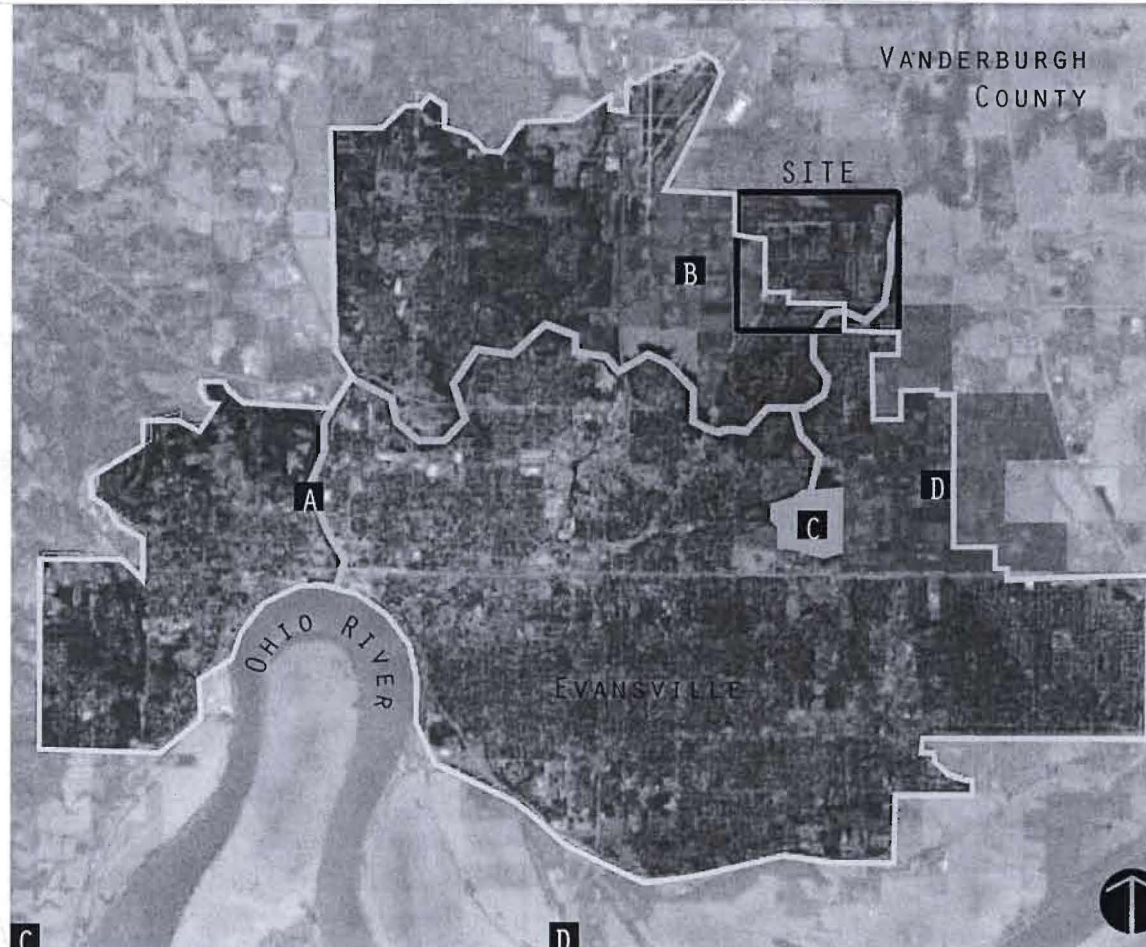


# SITE INVESTIGATION

## LOCATION AND CONTEXT

The site is located just northeast of Evansville, Indiana in Vanderburgh County. A fraction of the site lies within Evansville's boundary. The highlighted areas below are all important places to which site residents may currently connect only by car.

Figure 1.1: Evansville & Vanderburgh County, Image from Google Earth



**A**  
PIGEON CREEK  
- 41 miles long from origin east of Evansville to Ohio River  
- planned Pigeon Creek Greenway to run along the site's southern end

**B**  
INDUSTRIAL AREA  
holds places of employment and technical training for site residents

**C**  
WESSELMAN WOODS  
NATURE PRESERVE  
- old growth lowland forest and crucial animal habitat  
- just over a mile from the site

**D**  
COMMERCIAL AREA  
strip shopping area with large grocery store, indoor mall, and many restaurants



## THE SITE - FRAMEWORK AND FOCUS AREA

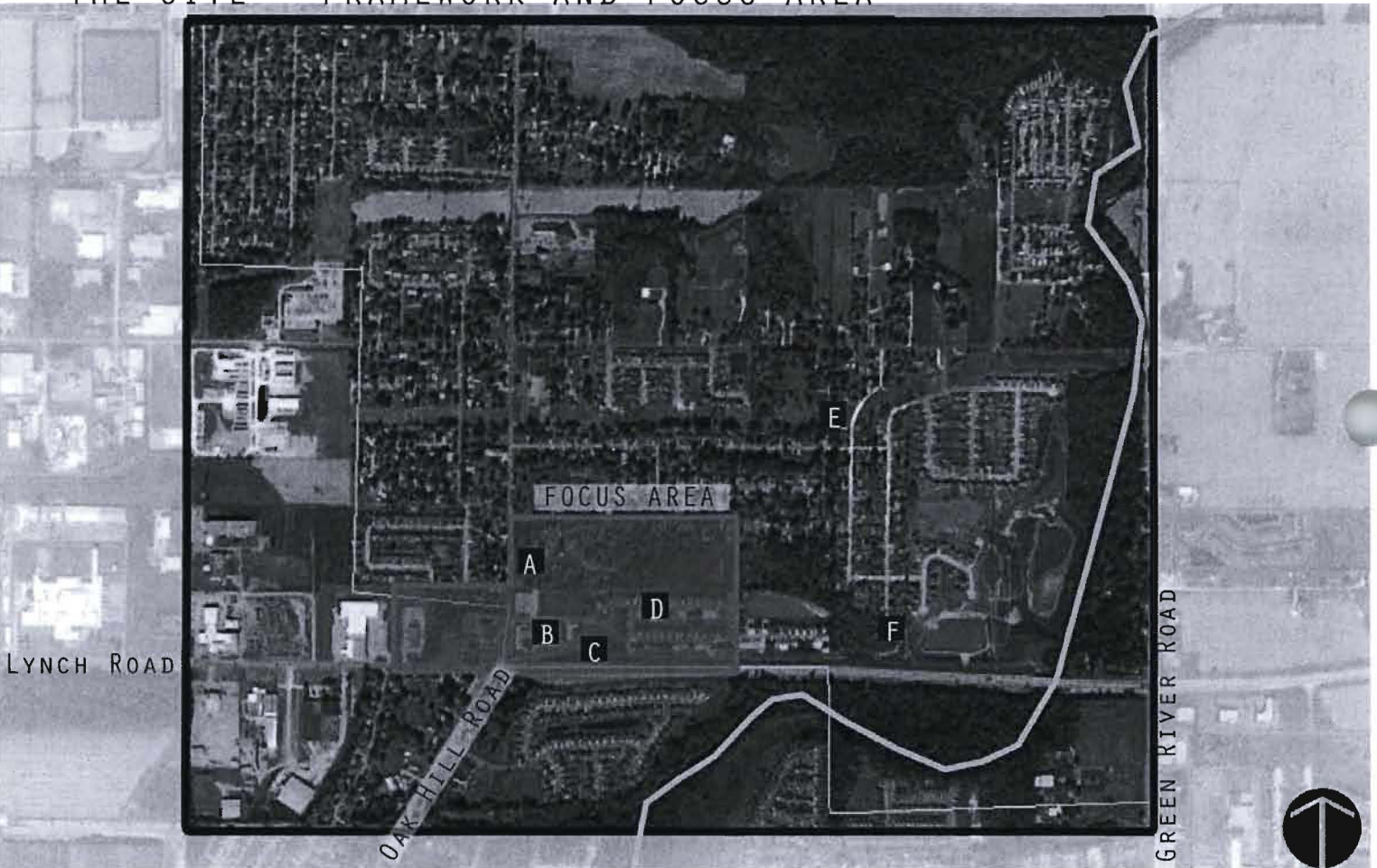


Figure 1.2 - The Site, Image from Google Earth

**Large Site Area:** 1,200 sq acres

**Focus Area:** 60 acres

The site includes a large area where I implemented general design improvements. With the smaller focus area I zoomed in on specific sites to illustrate sustainable design principles in detail.

**A**

FIGURE 1.3:  
1950s - 70s ERA  
NEIGHBORHOOD

- older, more varied home styles
- larger lawns: 1/3 - 1/2 acre properties
- no sidewalks
- hilly topography





# INVENTORY



**B**

**FIGURE 1.4:**  
**COMMERCIAL AREA**  
 - businesses only  
 accessible by car  
 - no shared drives  
 - tall, unattractive signs



**D**

**FIGURE 1.6:**  
**21ST CENTURY  
 NEIGHBORHOOD**  
 - similar-looking homes  
 - 1/5 - 1/4 acre  
 properties  
 - no sidewalks in this  
 example, but other  
 young neighborhoods  
 have sidewalks  
 - flatter topography



**E**

**FIGURE 1.7:**  
**POWER LINE  
 CORRIDOR**  
 - one of two mown  
 areas with power or  
 transmission lines  
 - does not support  
 wildlife or off-road  
 recreation



**C**

**FIGURE 1.5: NEIGHBORHOOD  
 RECREATION AREA**  
 - an example of the site's many  
 mown areas around retention lakes  
 - site lakes usually have gates or  
 restricted access signs  
 - no seating or play features



**F**

**FIGURE 1.8:**  
**CUL-DE-SAC EMPTINESS**  
 - one of many cul-de-sacs  
 abutting large empty spaces  
 between or near homes  
 - cul-de-sacs often face Pigeon  
 Creek or neighborhood lakes

## INVENTORY AND ANALYSIS

The circulation map below provides a simple picture of where roads and, therefore, missing connections are located. The flood zones map illustrates how the location of Pigeon Creek makes the site's eastern portion susceptible to flooding or slow drainage.

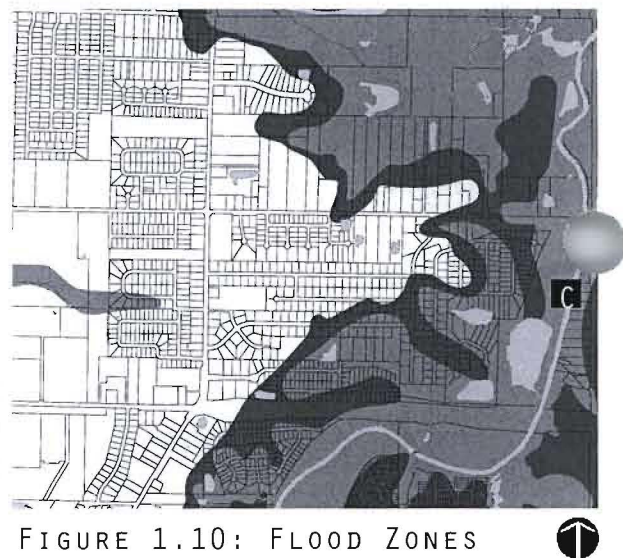
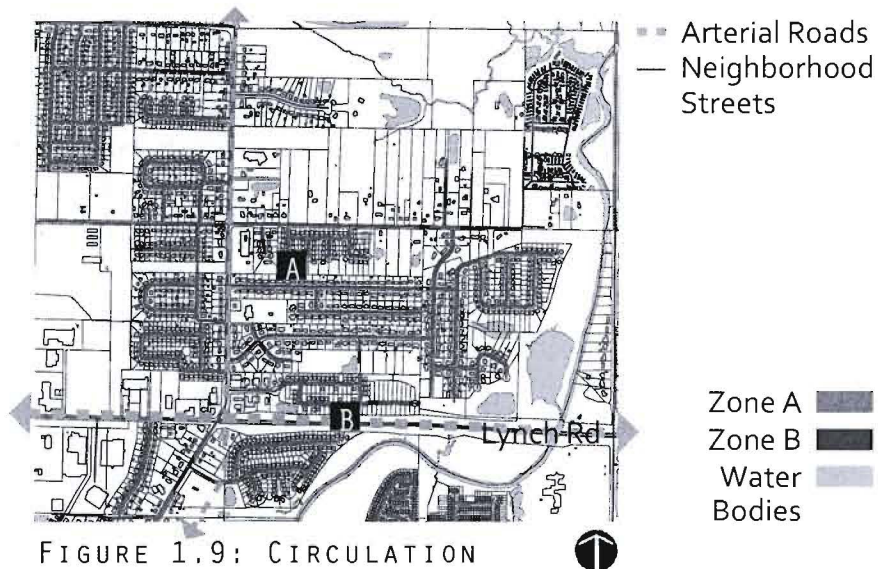


FIGURE 1.11  
MISSING CONNECTION  
A power line corridor prevents ecological and pedestrian connections between neighborhoods.



FIGURE 1.12  
NO ROAD CROSSING  
Lynch Road is a barrier to pedestrian and bicycle connections between neighborhoods and Pigeon Creek.



FIGURE 1.13  
PIGEON CREEK  
Land directly adjacent to the creek has been reconstructed in the past to protect homes from flooding, a common occurrence.



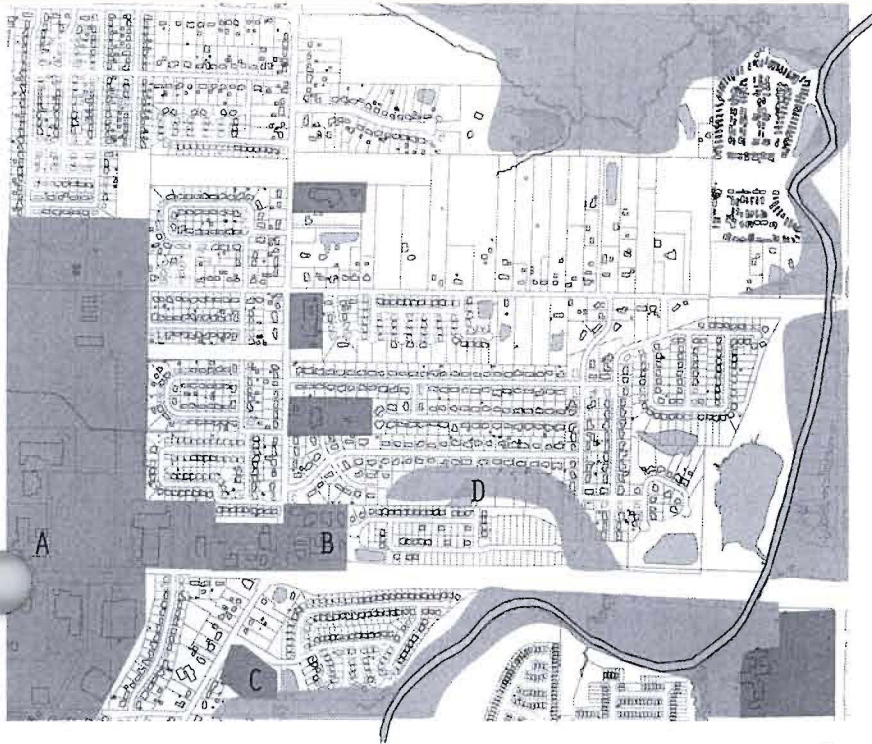


FIGURE 1.14: LAND USE ZONES



INDUSTRIAL

COMMERCIAL

INSTITUTIONAL

NATURAL

The map and images illustrate the site's various land uses (designated by me using, but not adhering to, official planning maps). All are areas to which pedestrian and bicycle connections could be made and more sustainable infrastructure could improve.



FIGURE 1.15  
TEMPLE-INLAND CO.



FIGURE 1.16  
CARWASH & DENTIST

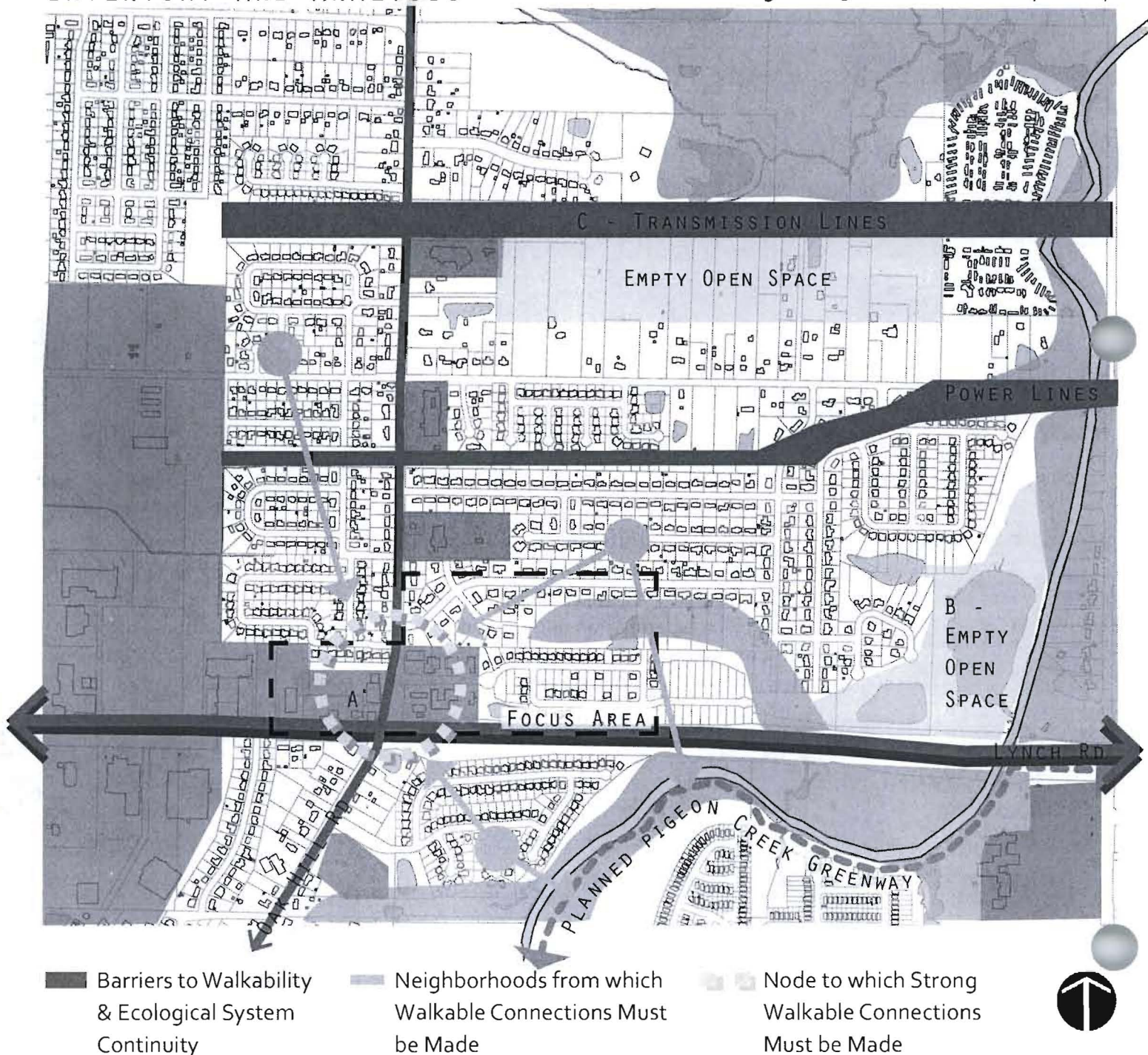


FIGURE 1.17  
OAKLYN LIBRARY  
- Green roof prairie serves as a model for sustainable design  
- Library provides a meeting center for site residents



FIGURE 1.18  
POND & WOODLAND









A

FIGURE 1.20

#### COMMERCIAL AREA

- not accessible to pedestrians and bicyclists
- opportunities for increased walkability and gathering



B

FIGURE 1.21

#### EMPTY OPEN SPACE

- opportunities for habitat expansion and recreation



C

FIGURE 1.22

#### TRANSMISSION LINES

- barrier to wildlife movement
- opportunity for recreation

The map (Figure 1.19) and images on these pages identify further constraints of the site and opportunities for improvement.

The red "barriers" locate the most obvious areas where pedestrian and ecological connections might be made, a continuation of the ideas expressed on page 21. The transmission line and power line zones currently pose significant obstacles as they must remain free of structural development or tall vegetation. Opportunities exist for planting prairie grasses and small shrubs and trees (under 30') to provide habitat for small birds and mammals. Lynch and Oak Hill Roads currently prevent safe pedestrian and bicycle crossing between neighborhoods and transportation to the commercial area. Sidewalks, bicycle lanes, and attractive intersection features might be added to these roads. Off-road paths might also be established throughout the site to connect residents with the area's ecological features and give people safe space to move apart from motor vehicles.

The commercial area itself is limited due to its lack of sidewalks and connected facilities. No spaces for gathering or leisure activities exist. Providing a more walkable environment and spaces for gathering and leisure might include adding sidewalks and plazas while locating parking towards the back or sides of new buildings.

Empty open space includes the areas where ponds are present but surrounded by mowed grass. No flowers, few trees, and little to no seating exists, and these areas, like the power line corridors, could be improved by adding trails and allowing nature to expand into each space.



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# DESIGN PRECEDENTS





Figure 2.1: Stormwater Planter<sup>19</sup>



Figure 2.2: Green Street Project Book Cover

## PORTLAND, OREGON — GREEN STREET PROGRAM

The Portland City Council officialized the Green Street Program in 2007 as part of an effort to reduce stormwater runoff and sewer system maintenance and construction costs, among other reasons. The many planning, design, and construction documents available on the Portland Bureau of Environmental Services Green Street Program website informed many of my site-scale design solutions.

**Portland Bureau of Environmental Services**  
City of Portland, Oregon

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**Green Street Steward Program**  
Volunteer to help maintain a green street in your community

**SE Clay Green Street Project**  
Planning is complete for this project from the Willamette River to SE 12th Avenue and final design concepts are available to view

**SW Montgomery Green Street Plan**  
A multi-block urban Green Street concept (8,099kb PDF Document)

**One Percent for Green**  
Funds for sustainable stormwater projects

**Green Street Details**  
Details and specifications for swales, planters and curb extensions

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Green Street Maps and Virtual Tours

**Gateway Green Streets February 2008 Master Plan**  
Right of way stormwater management in the Gateway Urban Renewal Area

**Portland Green Street Program**

The City of Portland is an urban area that benefits from comprehensive thinking and planning. In Portland, urban design, multi-modal transportation systems, watershed health, parks, open spaces, and infrastructure systems are all enhanced by integrated planning, design, and budgeting.

Portland is a leader in using strategies that manage stormwater runoff, enhance community and neighborhood livability, and strengthen the local economy. A street that uses vegetated facilities to manage stormwater runoff at its source is referred to as a Green Street. A Green Street is a sustainable stormwater strategy that meets regulatory compliance and resource protection goals by using a natural systems approach to manage stormwater, reduce flows, improve water quality and enhance watershed health.

In April 2007, the Portland City Council approved a Green street resolution, report, and policy to promote and incorporate the use of green street facilities in public and private development.

The council recognizes that a comprehensive Green Street approach is an important development strategy to:

- Reduce polluted stormwater entering Portland's rivers and streams;
- Improve pedestrian and bicycle safety;
- Divert stormwater from the sewer system and reduce basement flooding, sewer backups and combined sewer overflows (CSOs) to the

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[What is a Green Street?](#)

[I want to install a Green Street](#)

[Green Street Planting Plans](#)

[Green Streets Poster](#)

[2007 Vegetation Report](#)

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[Stormwater Solutions Handbook](#)

[Stormwater Management Manual](#)

[Monitoring results for Sustainable Stormwater Facilities](#)

[Awards](#)

[SW 12th Avenue Green Street](#)

[NE Siskiyou Green Street](#)

Figure 2.3: Portland Bureau of Environmental Services Website Links

## SEATTLE, WASHINGTON — SEA STREET

Completed in 2001, Seattle's Street Edge Alternatives (SEA Street) project provides a model for how neighborhood street drainage might be designed to more closely mimic natural, pre-development processes. I used general information and construction documents provided on the Seattle Public Utilities website to inform my own street-scale designs.

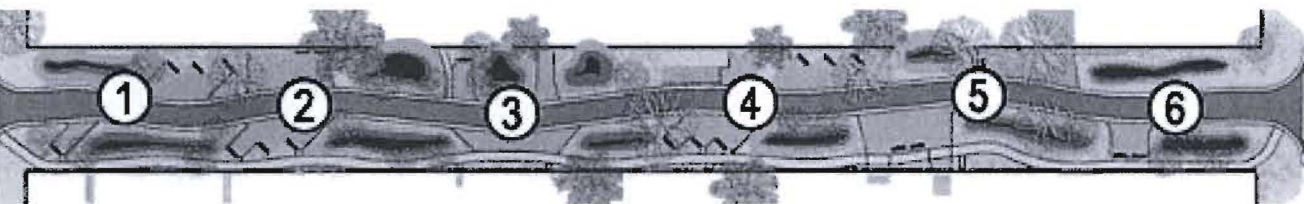


Figure 2.4:  
SEA Street  
Layout



Figure 2.5:  
SEA Street Bioswale



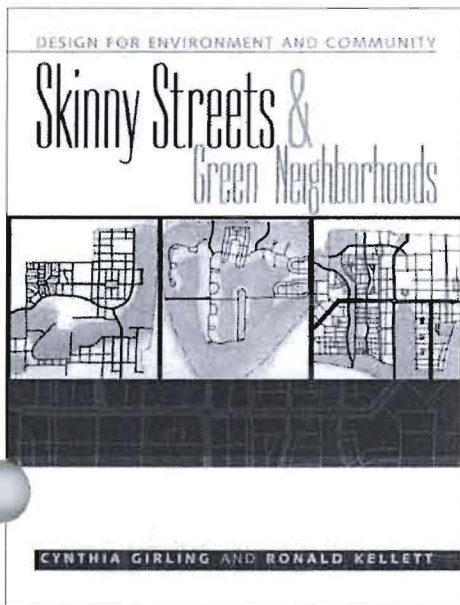


Figure 2.6: Skinny Streets  
Book Cover

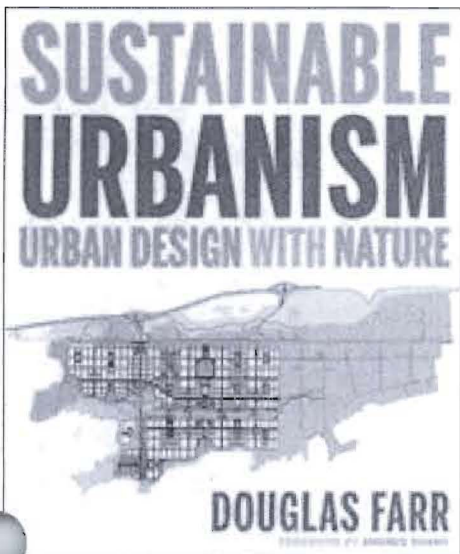


Figure 2.7: Sustainable  
Urbanism Book Cover

## OTHER PRECEDENTS

Much of today's suburban retrofit projects include infilling commercial areas and residential neighborhoods in large, low-density sites. As my design work largely focused on reshaping the land around existing structures, no particular examples of infill projects informed my work. Rather, I integrated planning and design principles gleaned from many different books and organization publications. The following is a short list of some of the more helpful books and organizations with websites and case studies. Full publishing information is listed within the bibliography at the end of this book.

### BOOKS :

*Skinny Streets & Green Neighborhoods*  
by Cynthia Girling and Ronald Kellett

*Sustainable Urbanism: Urban Design With Nature*  
by Douglas Farr

*Community by Design: New Urbanism for Suburbs and Small Communities*  
by Kenneth B. Hall and Gerald A. Porterfield

### ORGANIZATIONS :

Federal Highway Administration

Smart Growth Network

Sustainable Sites Initiative

Urban Land Institute

U.S. Green Building Council (LEED for Neighborhood Development)



# FRAMEWORK PLAN

## CONCEPT 1: EXPANDING WALKABLE ROUTES

For the 1,200 acre framework area I focused partly on expanding walkable and bikeable routes. I proposed improving the arterials (Lynch and Oak Hill) by adding sidewalks and bicycle lanes. A network of off-road trails could be added in the power line corridors and around empty open spaces.

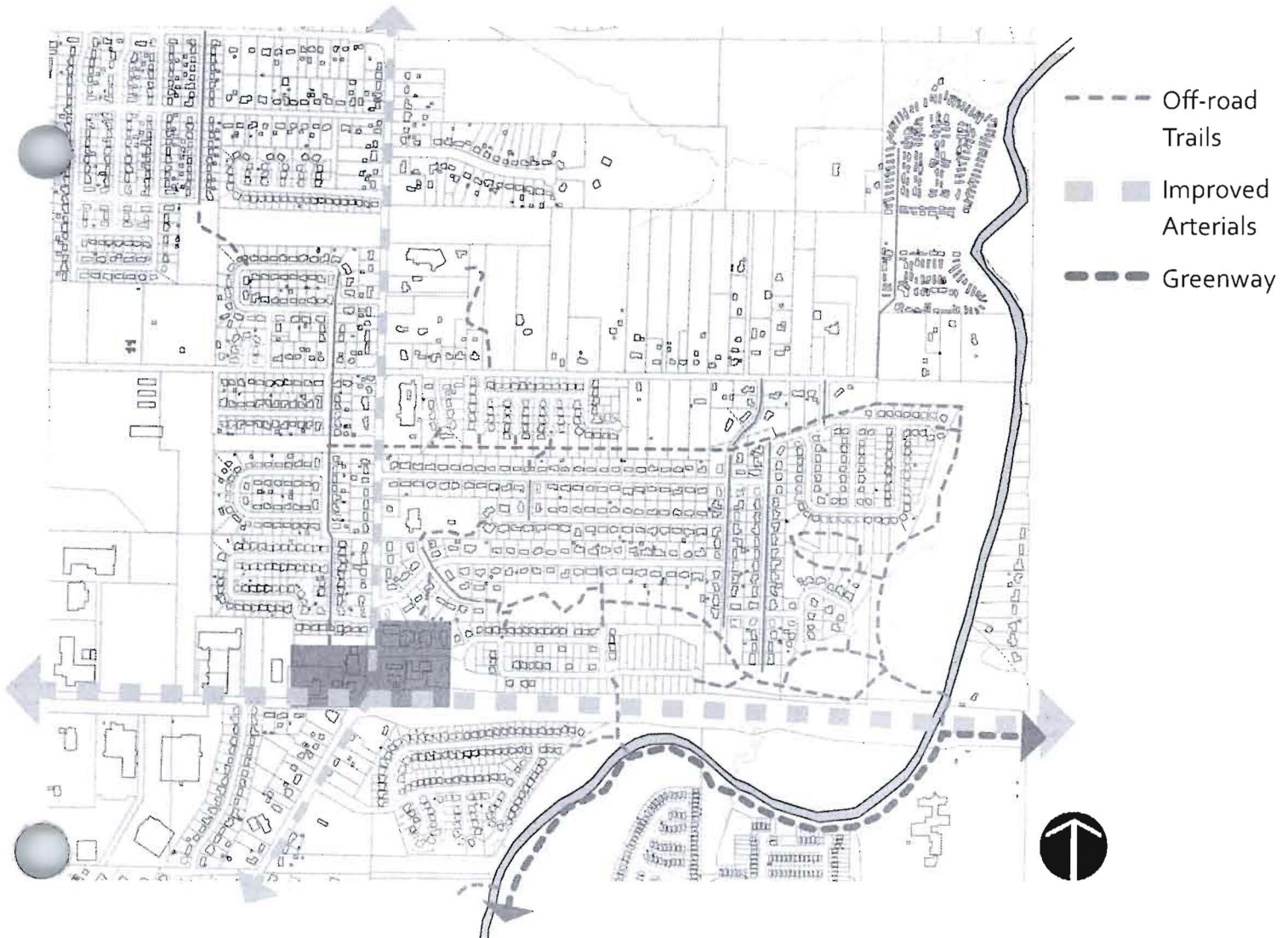


Figure 3.1: Improved Site Circulation



## CONCEPT 2: DEVELOPING THE ECOLOGICAL CORRIDOR

The second concept for the larger framework area includes expanding wildlife habitat. This may be achieved by filling power and transmission line corridors with native vegetation, though not tall trees. Empty open space may also be planted, or just allowed to grow over.

 Eco System Development

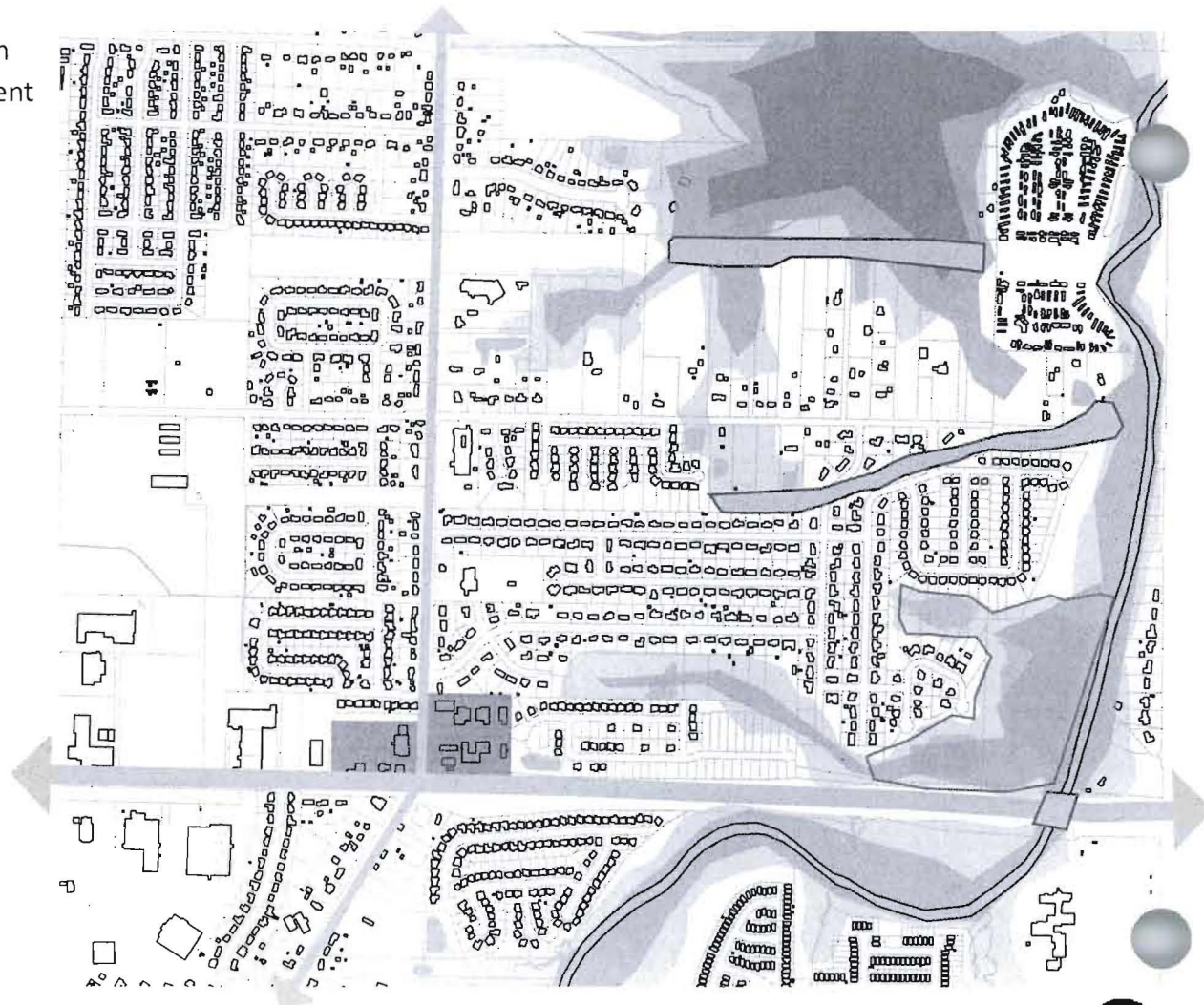


Figure 3.2: Ecological Corridor Expansion Areas



## THE FRAMEWORK PLAN

The framework plan combines the two preceding concepts and illustrates how circulation and ecological corridor development relate. Clearly, the area east of Oak Hill Rd requires the most changes. The black circles highlight areas in which framework plan concepts are illustrated on succeeding pages.

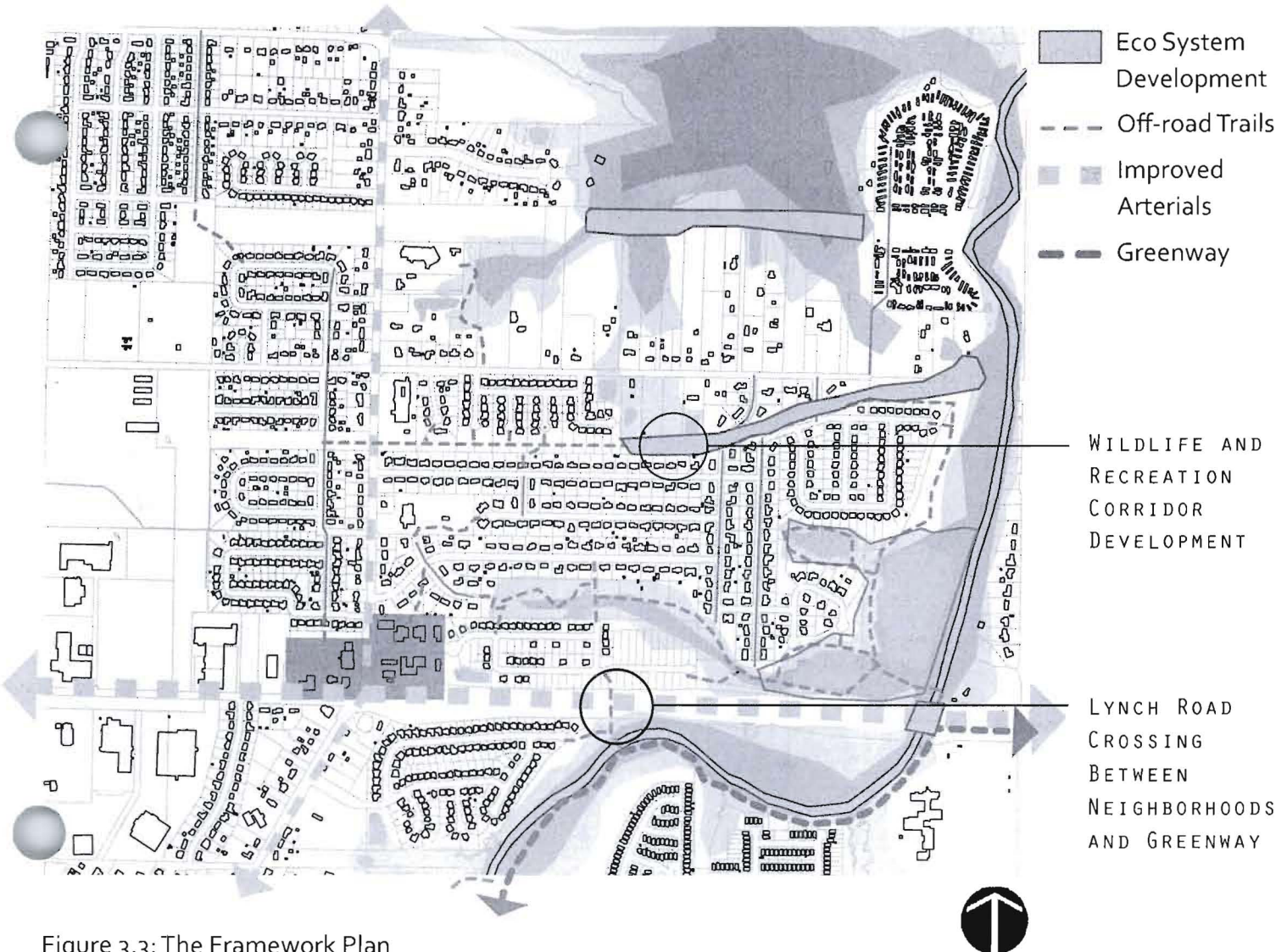


Figure 3.3: The Framework Plan

## WILDLIFE AND RECREATION CORRIDOR DEVELOPMENT

Where power and transmission lines run much of the grass is mowed, and no trails exist. The framework plan calls for an 8-10' wide trail and the planting of native grasses. Some shrubs and small trees might also be allowed to grow, but they must be maintained to a height under 30' so as not to damage the 40' high power lines. To be a completely viable project plantings would also have to meet regulations set in the Evansville Arboricultural Specifications Manual.



Figure 3.4: BEFORE - Conventional Power Line Corridor



FIGURE 3.5: AFTER - TRAIL RUNNING  
THROUGH EXPANDED ECOLOGICAL CORRIDOR



## LYNCH ROAD CROSSING BETWEEN NEIGHBORHOODS AND GREENWAY



Lynch Road currently possesses four lanes, a median, and wide shoulders. No sidewalks or bike lanes exist. As the road runs just north of where Pigeon Creek Greenway is planned to be constructed, a safe crossing for pedestrians and bicyclists would allow people from neighborhoods north of Lynch to access both the greenway and nearby neighborhoods on foot. The crossing could include a number of bright red stripes that alert drivers traveling 50mph to slower cross traffic. Lynch could become multi-modal through the addition of sidewalks and bike lanes.

Figure 3.6: BEFORE - Lynch Road As It Looks Now

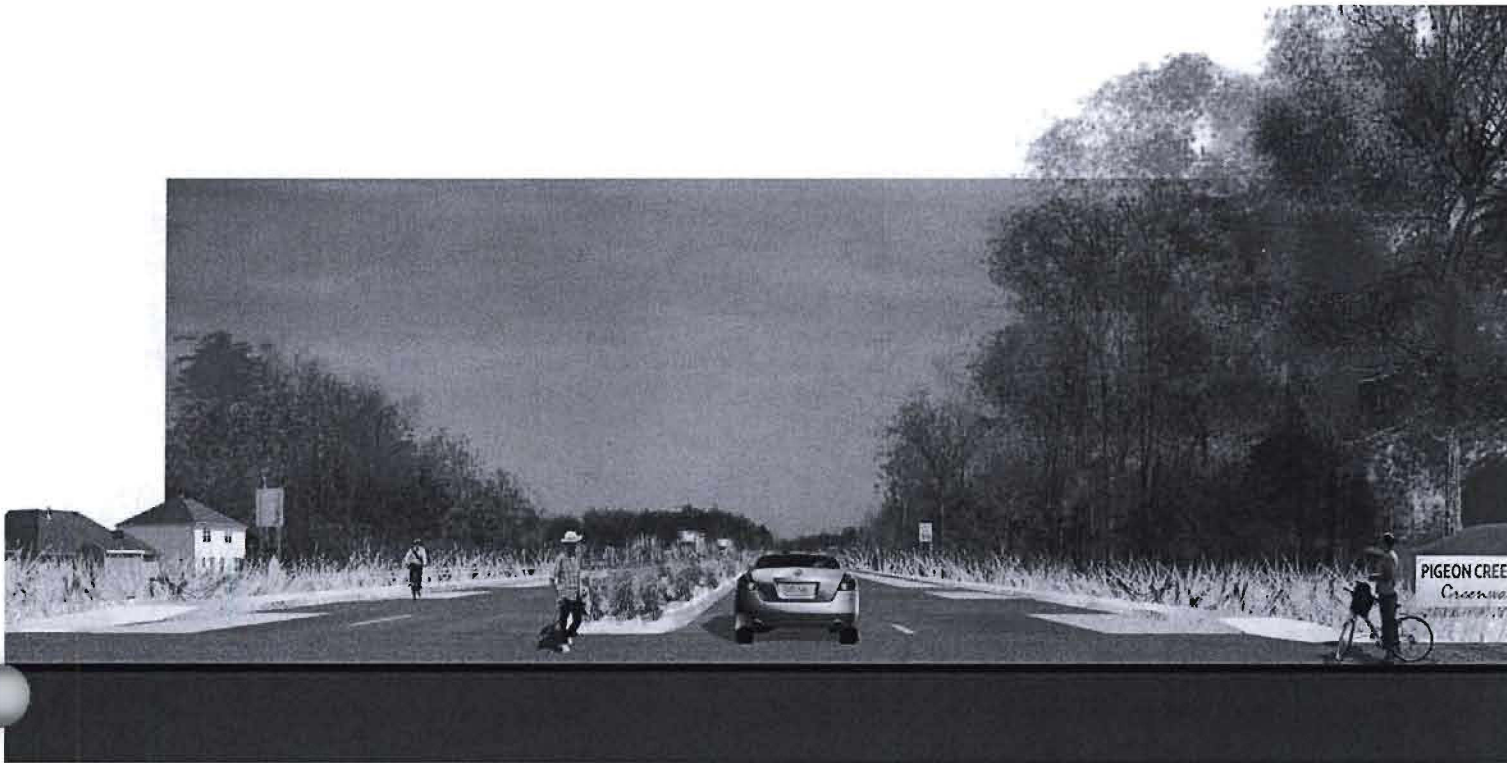


FIGURE 3.7: AFTER - LYNCH ROAD WITH PEDESTRIAN AND BIKE CROSSING, SIDEWALKS, AND BIKE LANES



# FOCUS AREA MASTER PLAN



## EXISTING CHARACTERISTICS

The focus area master plan expands on the framework concepts within an area that possesses four distinct zones: a commercial area, a neighborhood constructed between the 1950s and 70s, a neighborhood constructed after 2000, and a 6 acre woodland area. I addressed the woodland only within the master plan but provided site design examples for the other zones. Those may be viewed in the next section (Site Design).

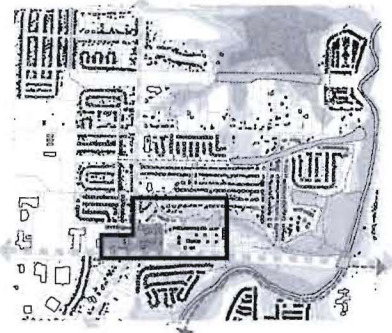


Figure 4.1: Framework Plan  
& Focus Area



Figure 4.2:  
Focus Area

COMMERCIAL  
AREA

1

2

50s-70s  
NEIGHBORHOOD

3

21ST CENTURY  
NEIGHBORHOOD

## FOCUS AREA CHARACTER



Figure 4.3: Focus Area Businesses

- 1** EXISTING BUSINESSES:
- A** German American Bank
  - B** CVS
  - C** Dollar General
  - D** Moto Mart
  - E** Pit Stop Car Wash
  - F** Dentist



FIGURE 4.4: DOLLAR GENERAL "Box"



These images illustrate the character of the focus area commercial zone and differences between the older and younger neighborhood zones.

2



FIGURE 4.5  
50S-70S NEIGHBORHOOD  
- varied home styles  
- larger lawns:  $\frac{1}{3}$  -  $\frac{1}{2}$  acres  
- hilly topography

3



FIGURE 4.6  
21ST CENTURY NEIGHBORHOOD  
- similar-looking homes  
-  $\frac{1}{5}$  -  $\frac{1}{3}$  acre properties  
- flatter topography

1

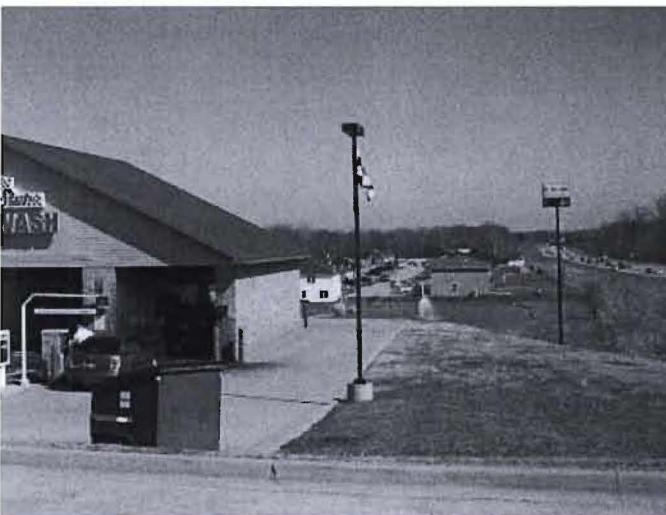


FIGURE 4.7: VIEW TO RESIDENCES

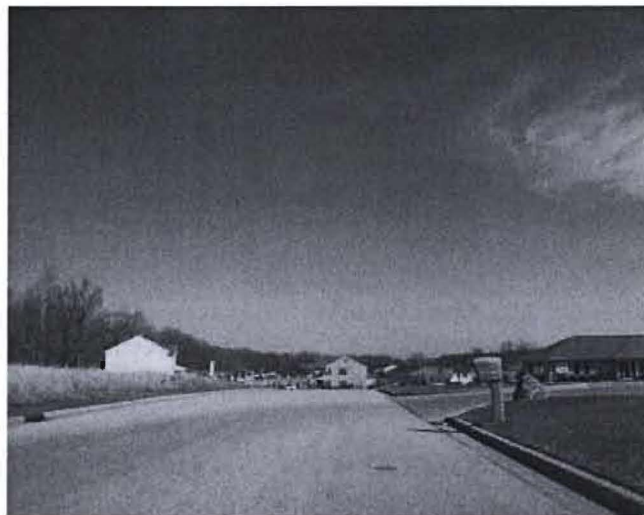


FIGURE 4.8: MAIN ROAD (MARINER)

## CONCEPT 1: FORMING A MULTI-MODAL TRANSPORTATION NETWORK

Concept 1 explores how the focus area might become more walkable and bikeable.

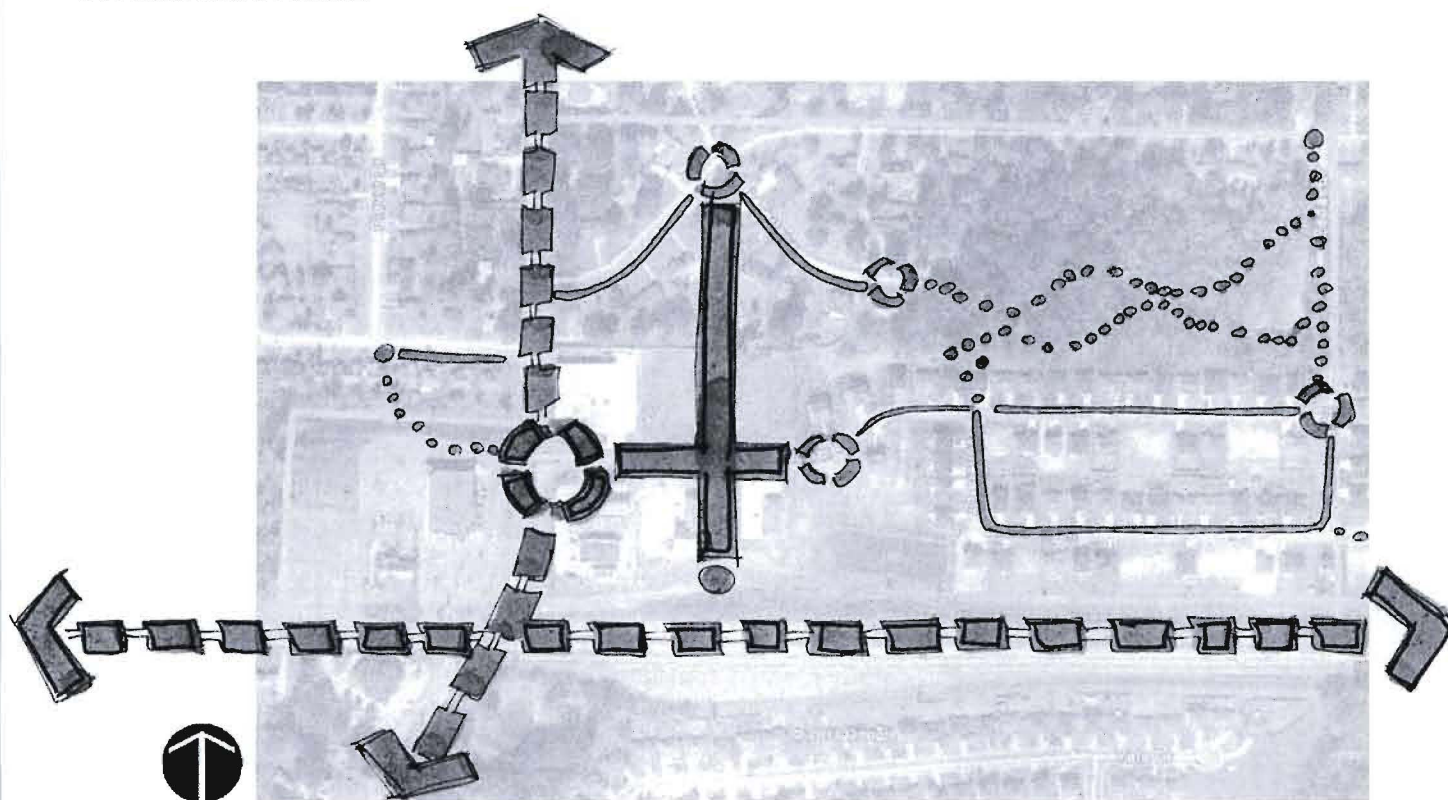


FIGURE 4.9: CIRCULATION



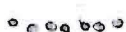
Add bike lanes and sidewalks to arterials (Oak Hill & Lynch Roads)



Add sidewalks to neighborhood roads



Form axial connection between neighborhoods and commercial area through path hierarchy



Integrate off-road paths into natural areas



Emphasize intersections and zone connections through common aesthetics



## CONCEPT 2: FORMING A GREEN NETWORK

Concept 2 illustrates how natural features may be protected through preservation and the integration of more sustainable infrastructure into the site. I also explored where to add parks to increase opportunities for recreation and socialization.

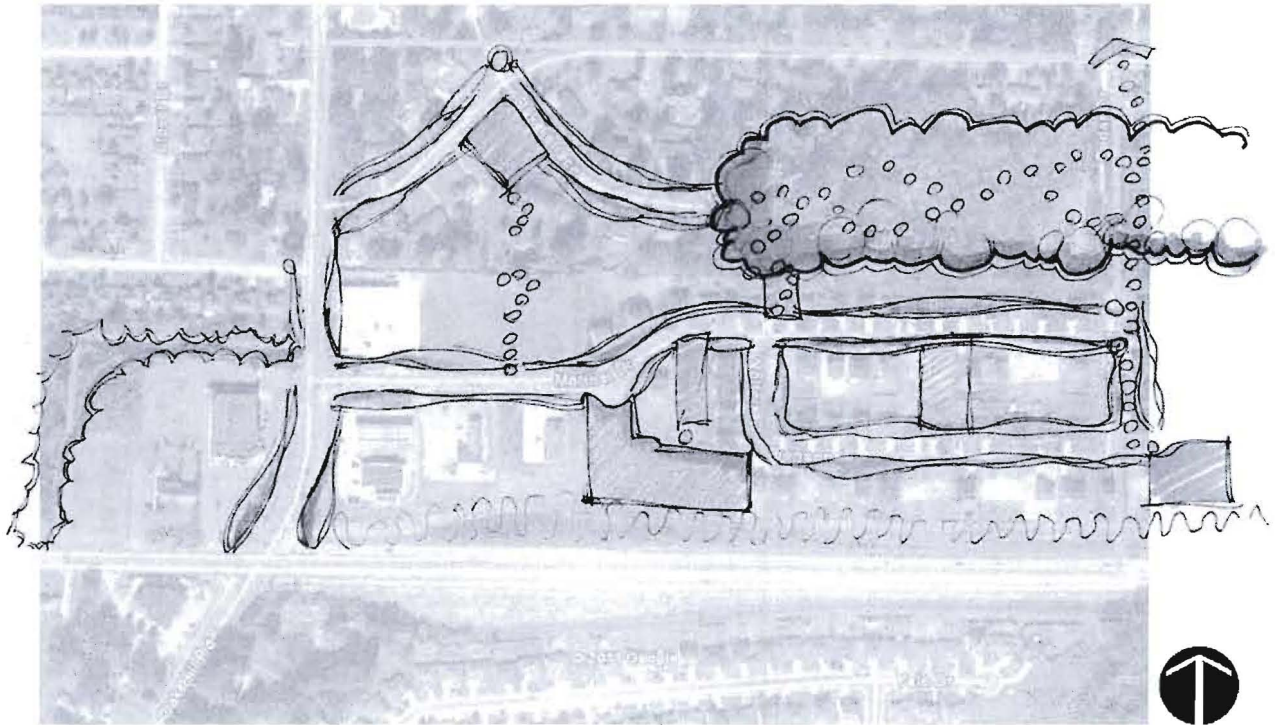


FIGURE 4.10: GREEN NETWORK  
Establish new neighborhood park areas



Integrate natural drainage systems alongside  
neighborhood streets and Oak Hill Rd



Preserve woodland

## 1 COMMERCIAL AREA DEVELOPMENT CONCEPTS

The commercial area is the only zone to gain new structures, or infill. I explored various design concepts for the entire commercial area as part of the master planning process.

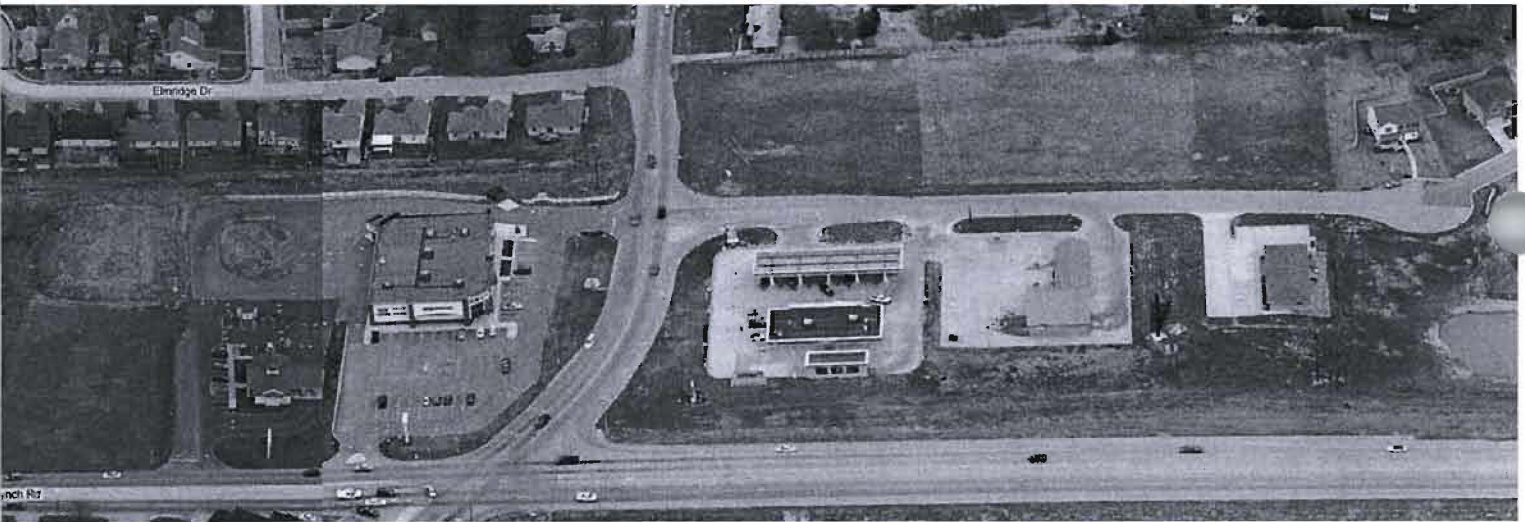


FIGURE 4.11: CURRENT CONDITION (minus the Dollar General)

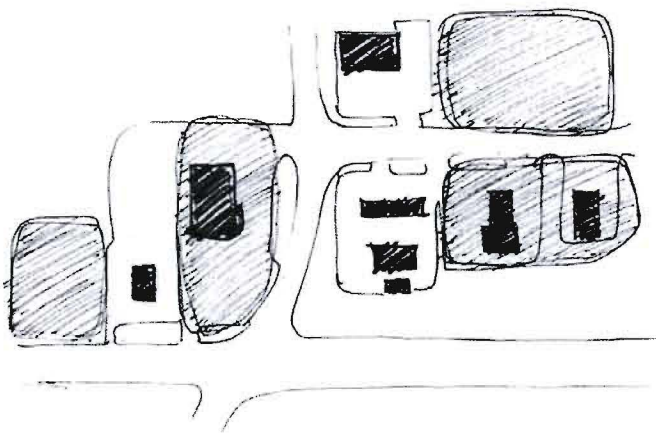


FIGURE 4.12: MORE SUSTAINABLE  
Develop Around Existing Structures

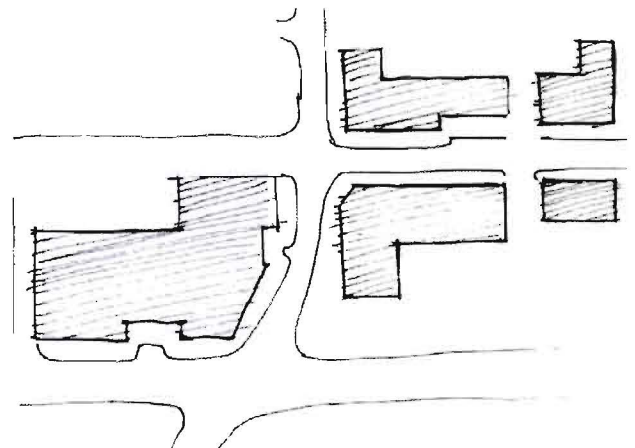


FIGURE 4.13: MORE URBAN  
Develop New Structures Entirely

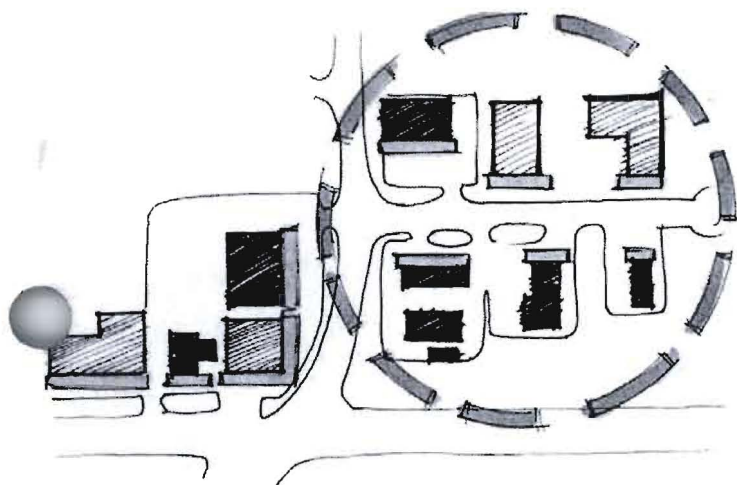


Figure 4.14: Maintain Building Rhythm and Side Parking Lots

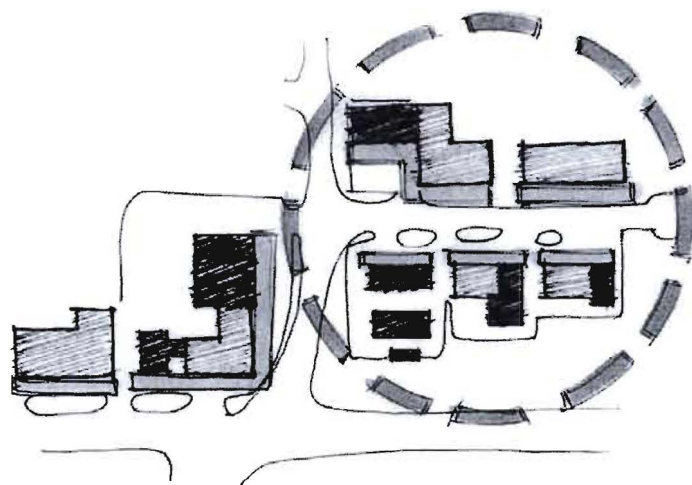


Figure 4.15: Increase Enclosure and Put Parking Behind Buildings

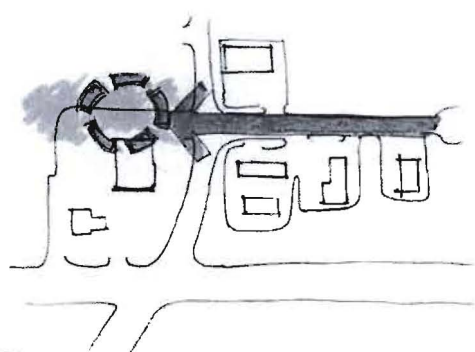


Figure 4.16: Focus Design Towards Western Park

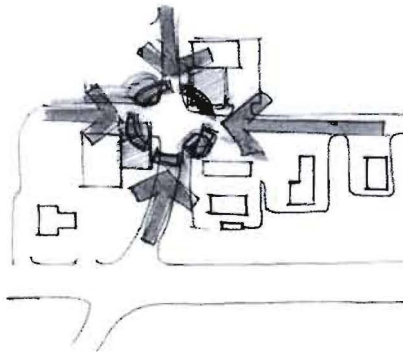


Figure 4.17: Focus Design Towards Intersection

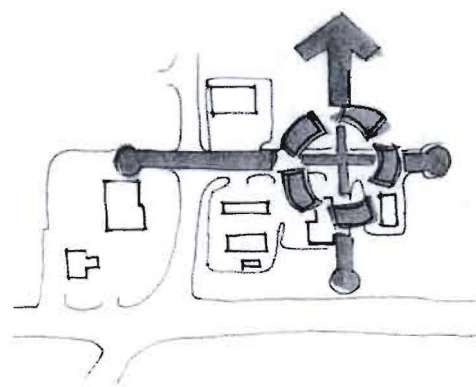


Figure 4.18: Focus Design on Axis



## THE MASTER PLAN

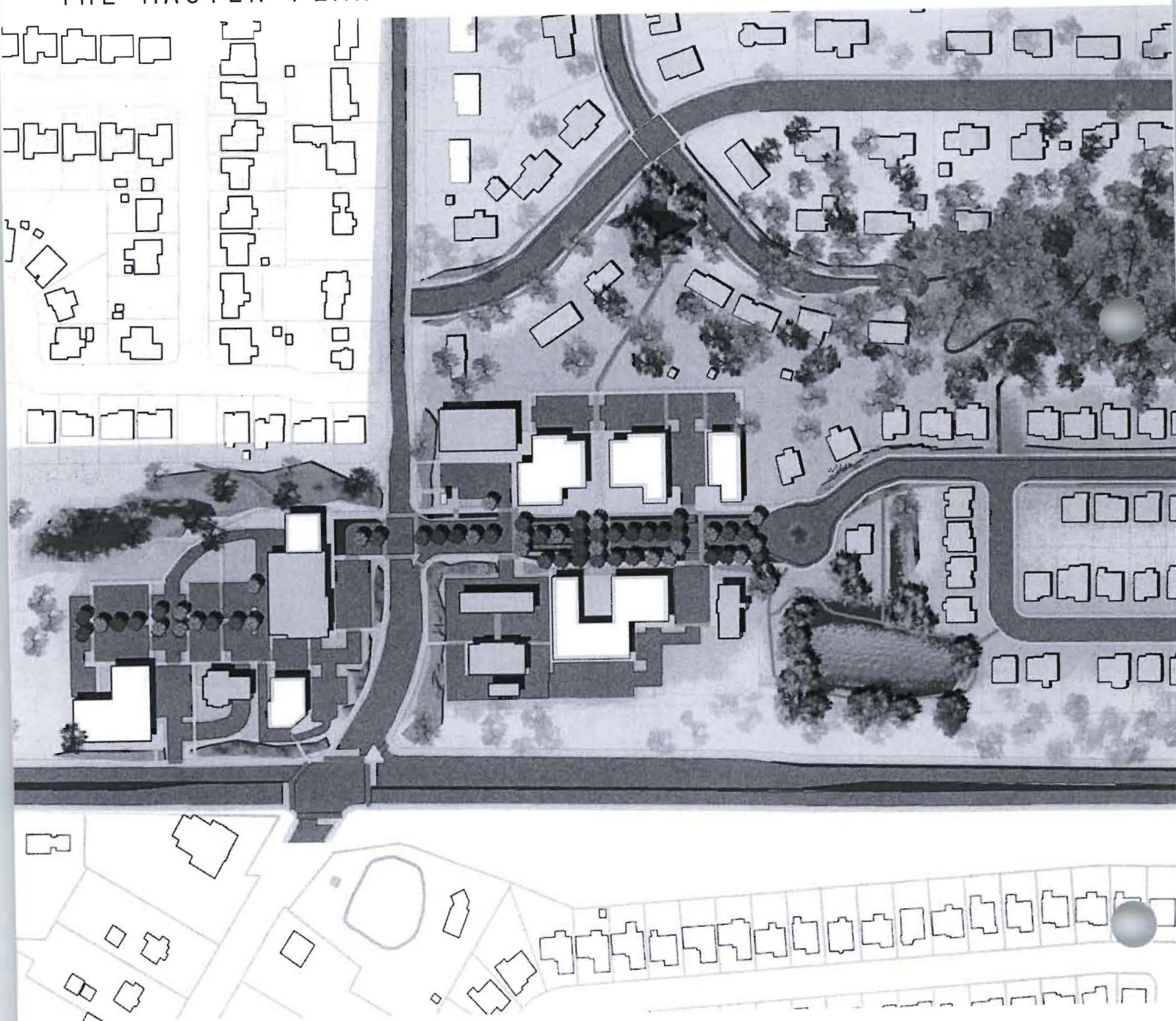
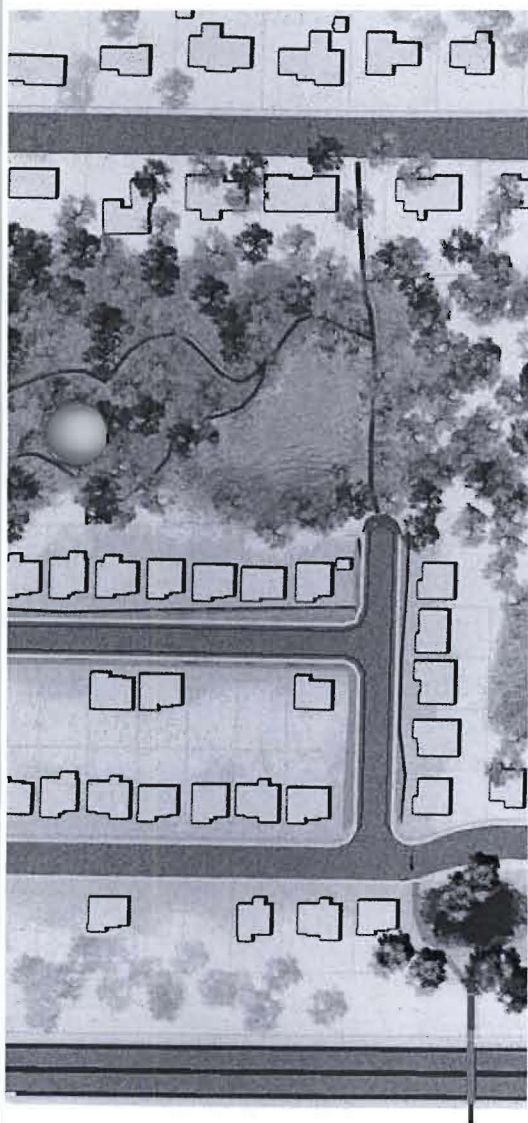
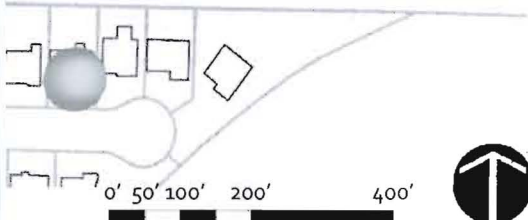


Figure 4.19: Master Plan



-  CROSSWALKS
-  OFF-ROAD TRAILS
-  STORMWATER TREATMENT
-  BOULEVARD/  
GREEN STREET
-  PARK
-  EXISTING STRUCTURE
-  NEW BUILDING

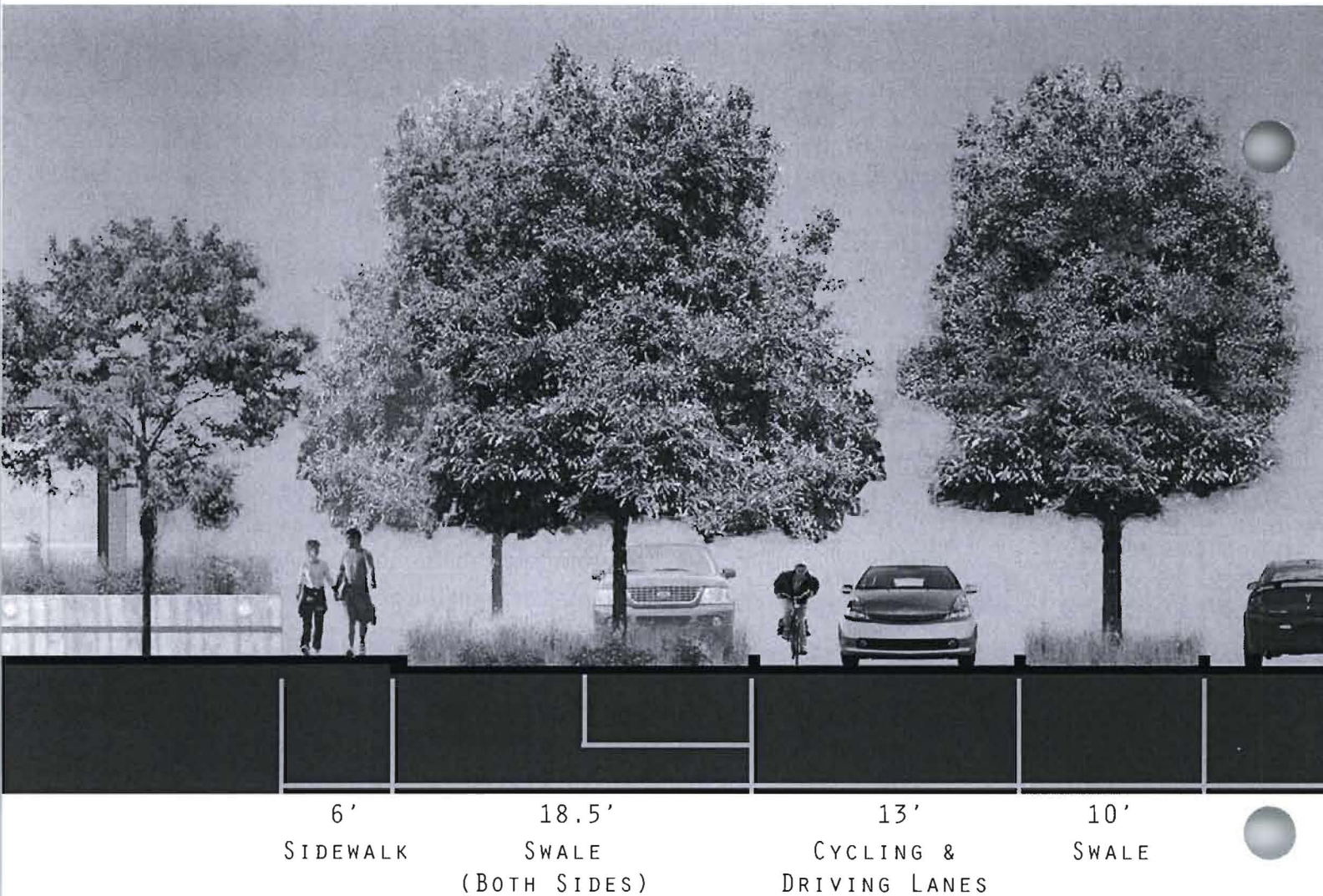
Changes and additions to the focus area are illustrated within this plan. The configuration of new commercial buildings complements the existing by forming more pedestrian-friendly enclosures and spaces. Parking is, meanwhile, focused towards the back of buildings and on Mariner Drive, a boulevard street that creates a comfortable, multi-modal environment. An off-road trail system runs through the preserved woodland and connects with the sidewalks and parks added to the different neighborhoods. Finally, I attempted to illustrate how sustainable infrastructure, such as bioswales and raingardens as part of natural drainage systems, might be integrated into the site. These additions mostly appear along roads and may help educate passersby about the importance of managing stormwater and its pollutants on-site.





# 1 MARINER DRIVE: ILLUSTRATING THE MULTI-MODAL STREET

Figure 4.20 illustrates how a multi-modal road might look. I designated this street, Mariner Drive, as a boulevard with its wide sidewalks and drainage features. However, the same general elements may be applied to Oak Hill and Lynch Roads.





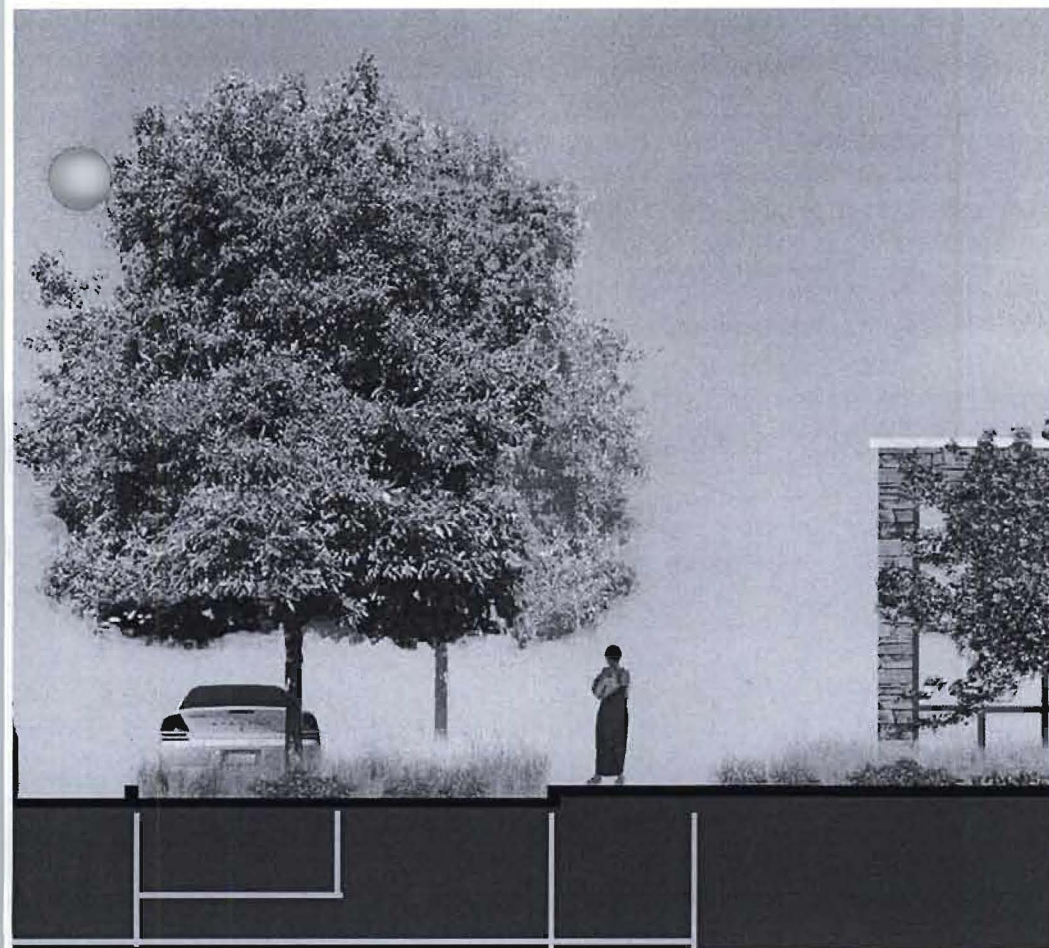


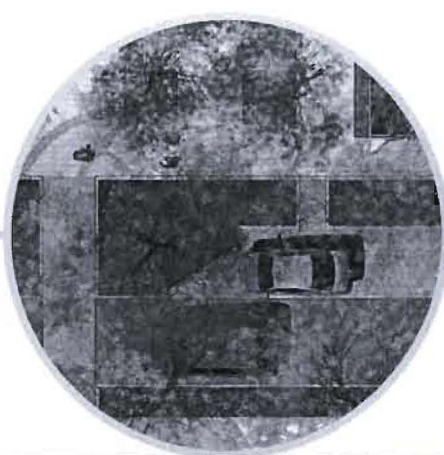
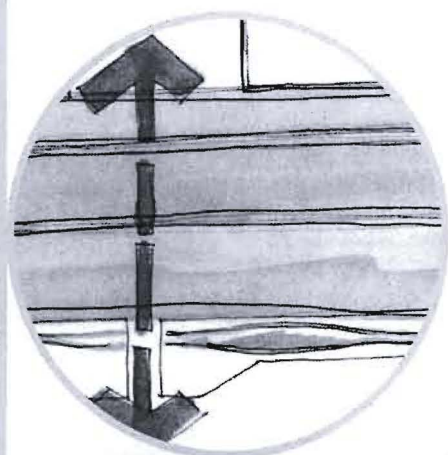
Figure 4.20: Section of Mariner Drive



8'  
PARKING  
(BOTH SIDES)

6'  
SIDEWALK

0' 5' 10' 20' 40'



# SITE DESIGN

## SITE DESIGN LOCATIONS

The areas circled below represent the three locations where I explored sustainability principles within detailed site designs. In the two neighborhoods I completed plans and illustrations of basic design concepts. For the commercial area I focused on the central plaza space and developed a plan, illustrations, a vegetation palette, and construction details.

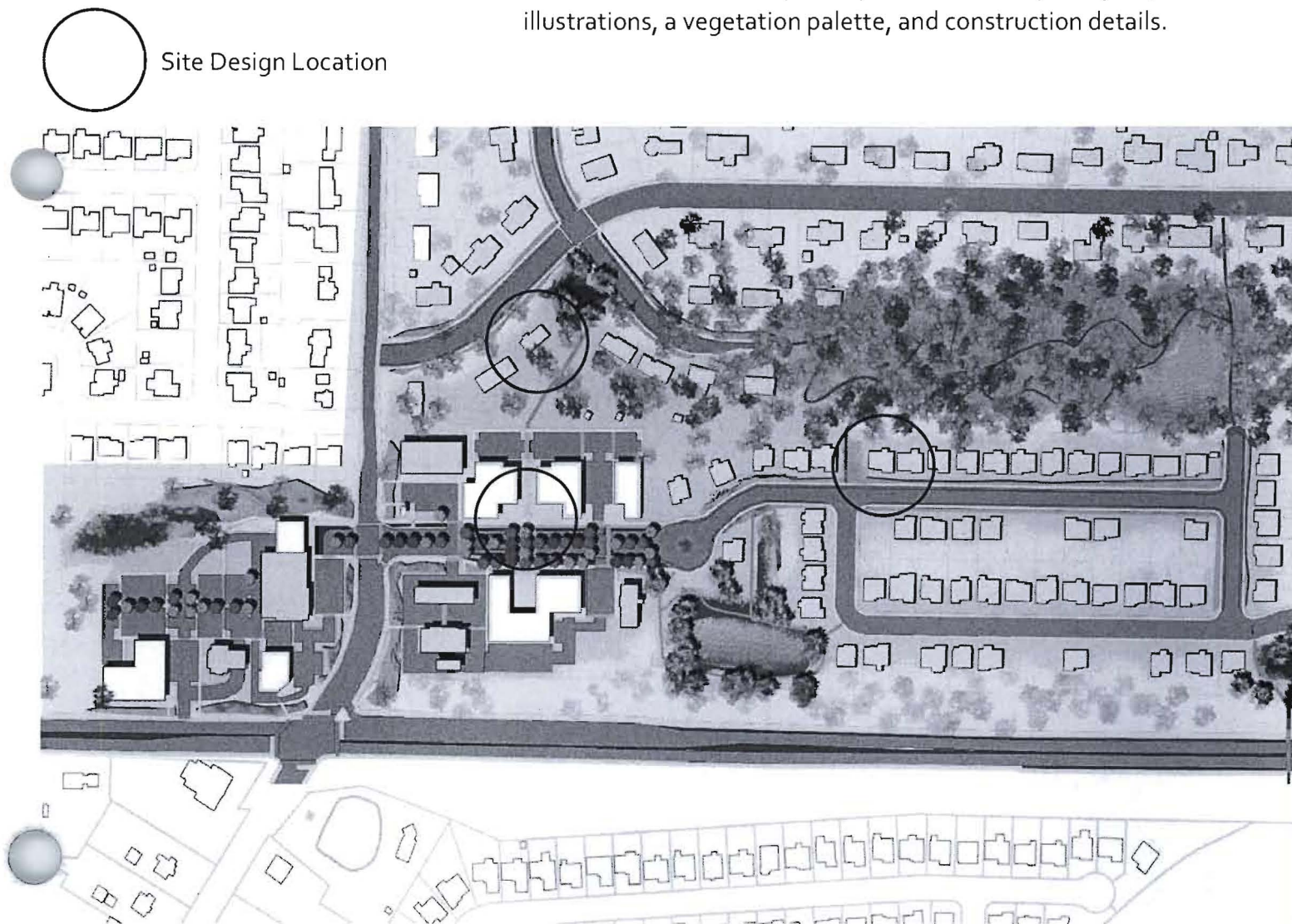


Figure 5.1: Site Design Locations



## 2 50s - 70s NEIGHBORHOOD PROGRAM & CONCEPT

I applied the following programmatic elements to the 50s - 70s neighborhood site largely to encourage better stormwater management and reduce impervious surfaces.

- Construct **vegetated swale** along street to infiltrate water and filter runoff from yard and road
- Plant **native vegetation** around site to prevent runoff and provide small animal/butterfly habitat
- Include **herb and vegetable gardens** to encourage consumption of local food
- Construct **patio** to provide comfortable space for socialization and relaxation
- Construct **path** between homes to the north and southerly commercial area to connect residents to services

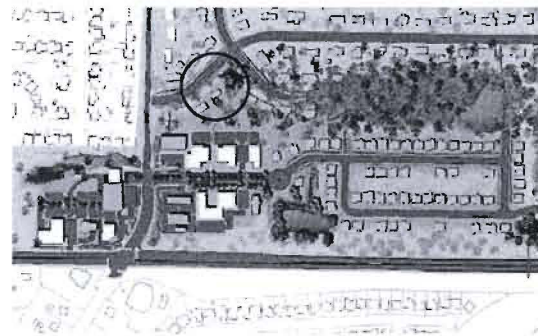


Figure 5.2: Site Design Location



Figure 5.3: The Site

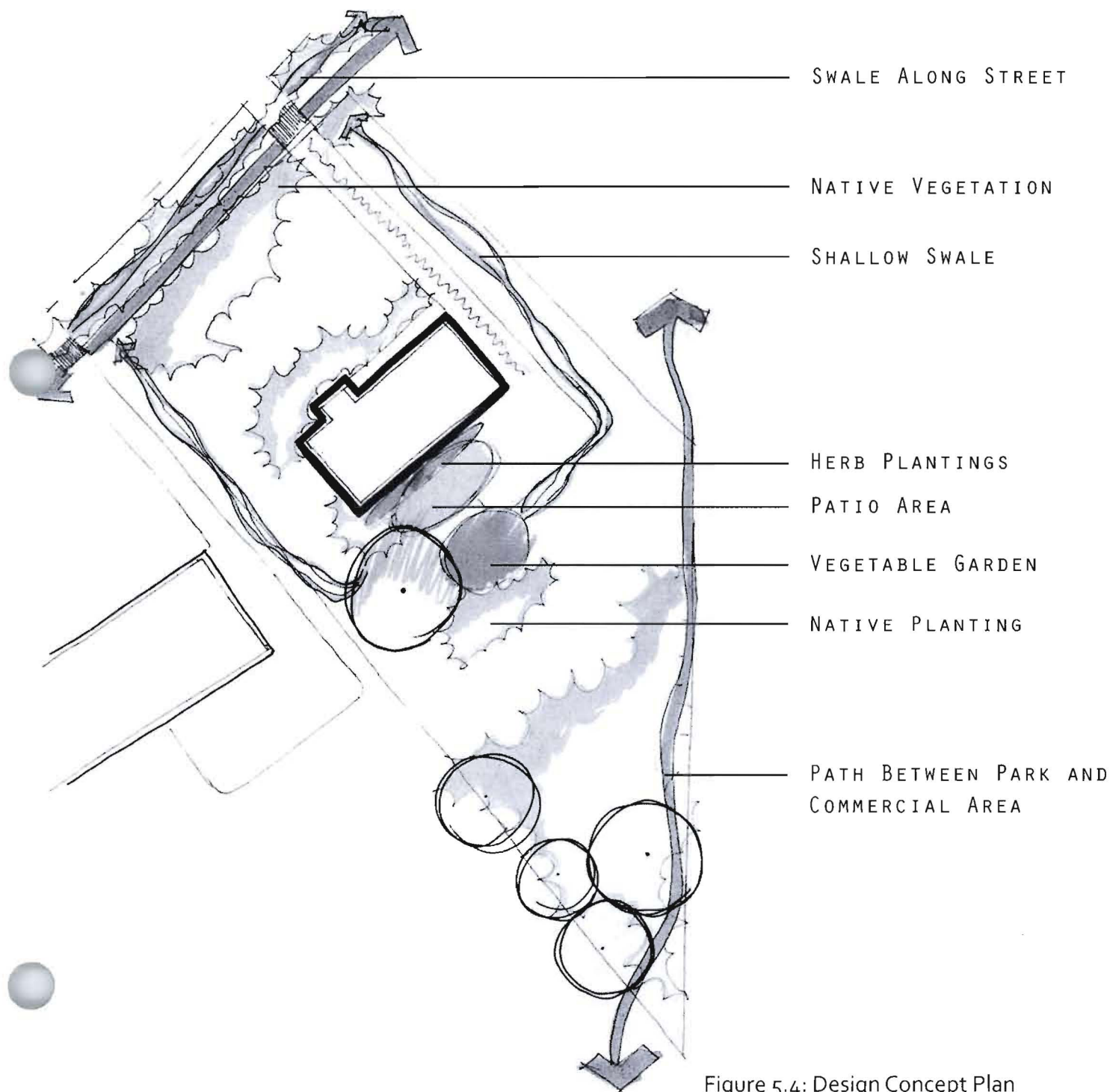


Figure 5.4: Design Concept Plan

## 2 50s - 70s NEIGHBORHOOD PLAN



10' WIDE SWALE BETWEEN STREET AND 4' WIDE SIDEWALK

NATIVE VEGETATION ON HILLSIDE

SHALLOW SWALE

3' WIDE DRIVEWAY PLANTING STRIP

8' LONG HERB PLOT

20' LONG PATIO

RAINWATER CISTERN

VEGETABLE GARDEN (8' LONG RAISED PLANTERS)

5' WIDE PATH BETWEEN PARK AND COMMERCIAL AREA

Figure 5.5: 50s - 70s Neighborhood Plan

0' 10' 20' 40' 80'





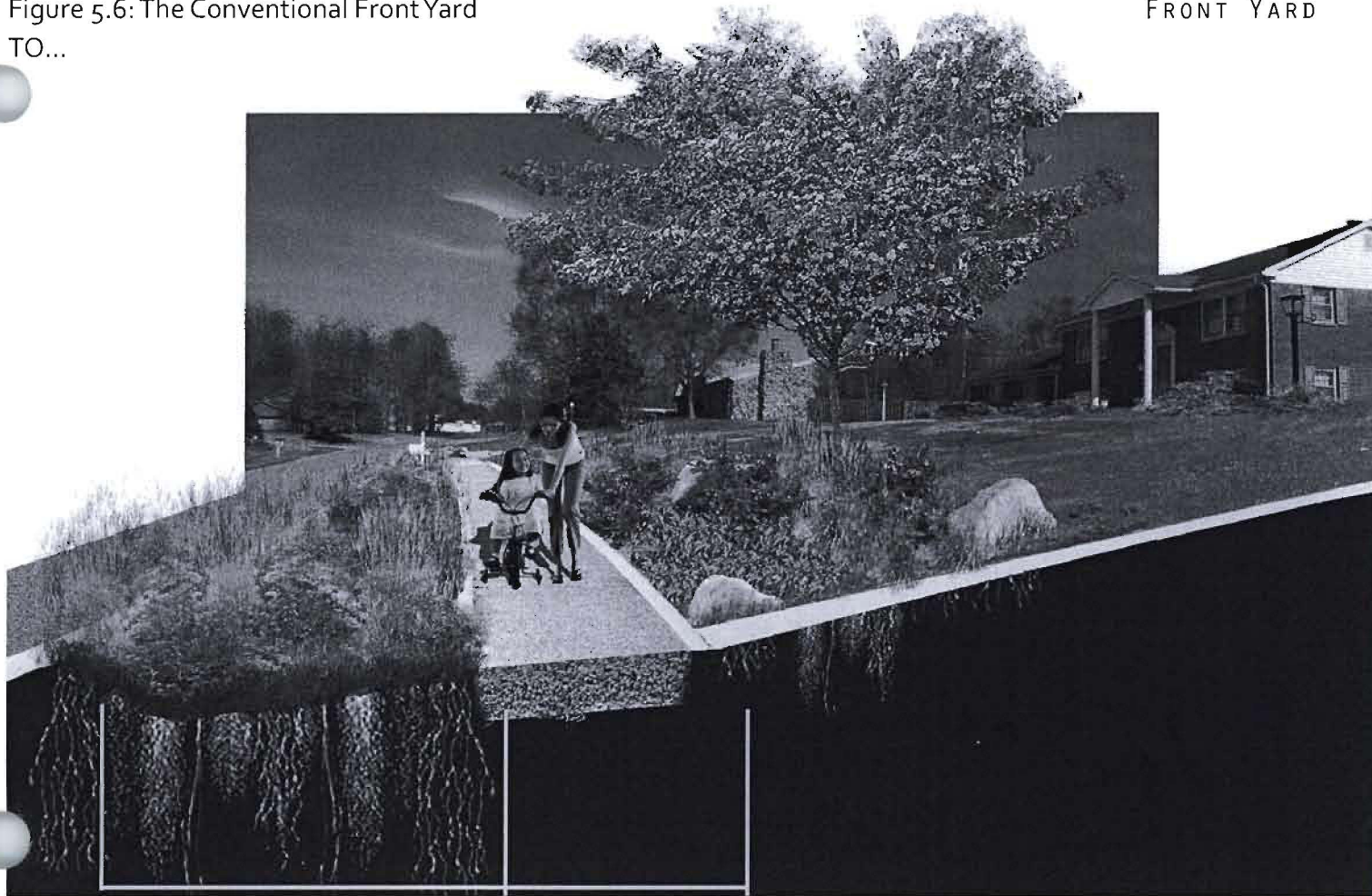


Figure 5.6: The Conventional Front Yard TO...

## THE EXPERIENCE ALONG THE STREET

The natural drainage system in Figure 5.7 will infiltrate stormwater and filter out pollutants, reducing the amount of waste headed to nearby Pigeon Creek. The native vegetation, such as Indian grass, false sunflower, and dwarf crested iris also lends color and interest to the site.

FIGURE 5.7: A  
STORMWATER FILTERING  
FRONT YARD



10' WIDE  
VEGETATED SWALE

4' WIDE WALK WITH  
PERVIOUS CONCRETE

### 3 21ST CENTURY NEIGHBORHOOD PROGRAM & CONCEPT

I applied the following programmatic elements to the 21st century neighborhood site. The design is similar to that of the 50s - 70s neighborhood; however, a park adds an additional recreational amenity to this site.

- Construct **vegetated swale** along street to infiltrate water and filter runoff from yard and road
- Plant **native vegetation** around site to prevent runoff and provide small animal/butterfly habitat
- Include **herb and vegetable plots** in both private yards and neighborhood park
- Provide **playground** and **game area** within park to encourage socialization with neighbors
- Connect to 50s-70s neighborhood through **woodland path**



Figure 5.9: The Site

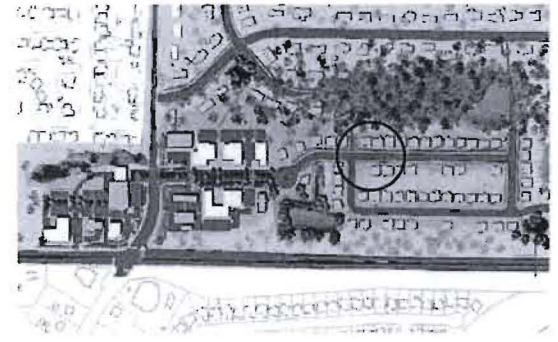


Figure 5.8: Site Design Location

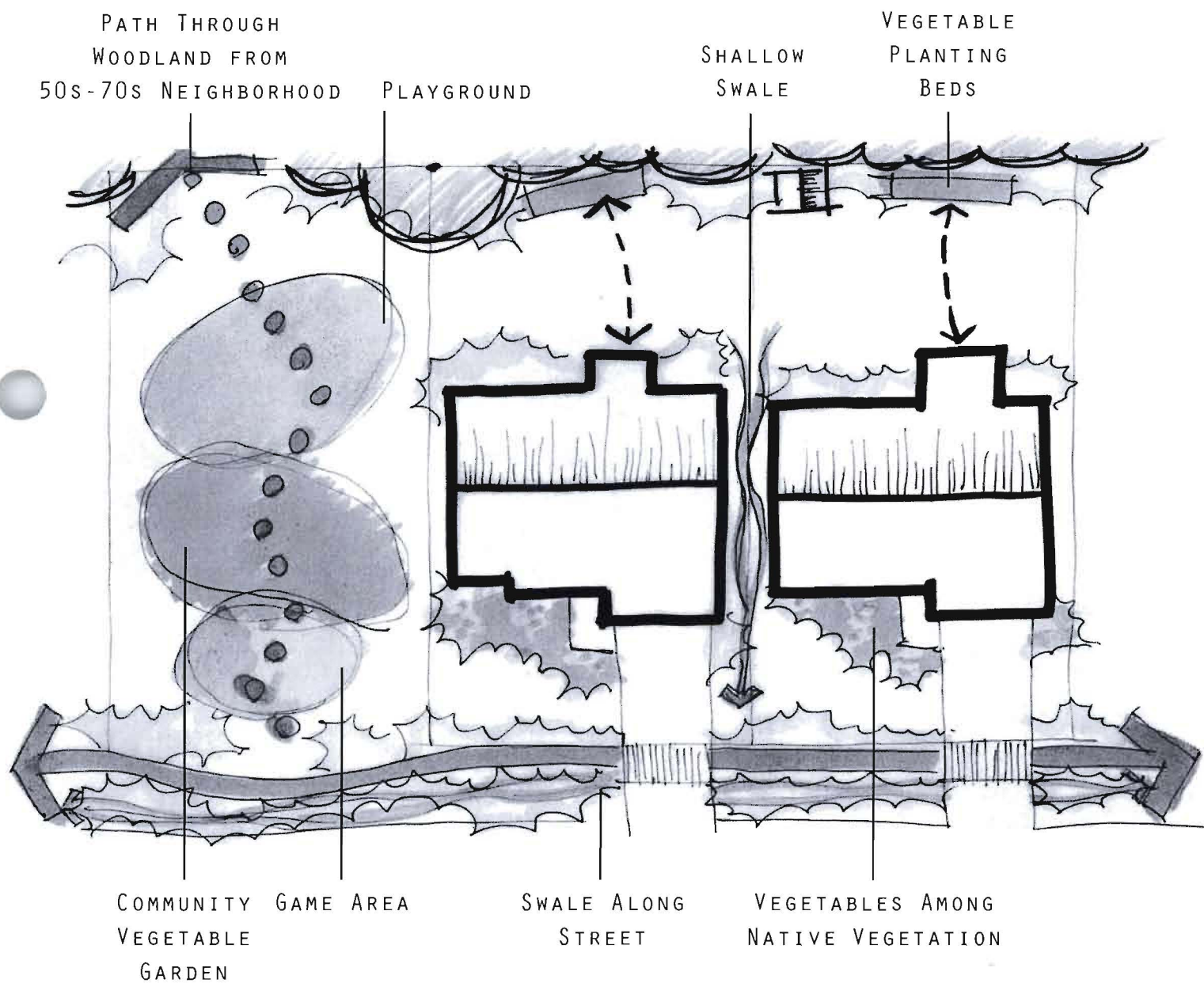


Figure 5.10: Design Concept Plan



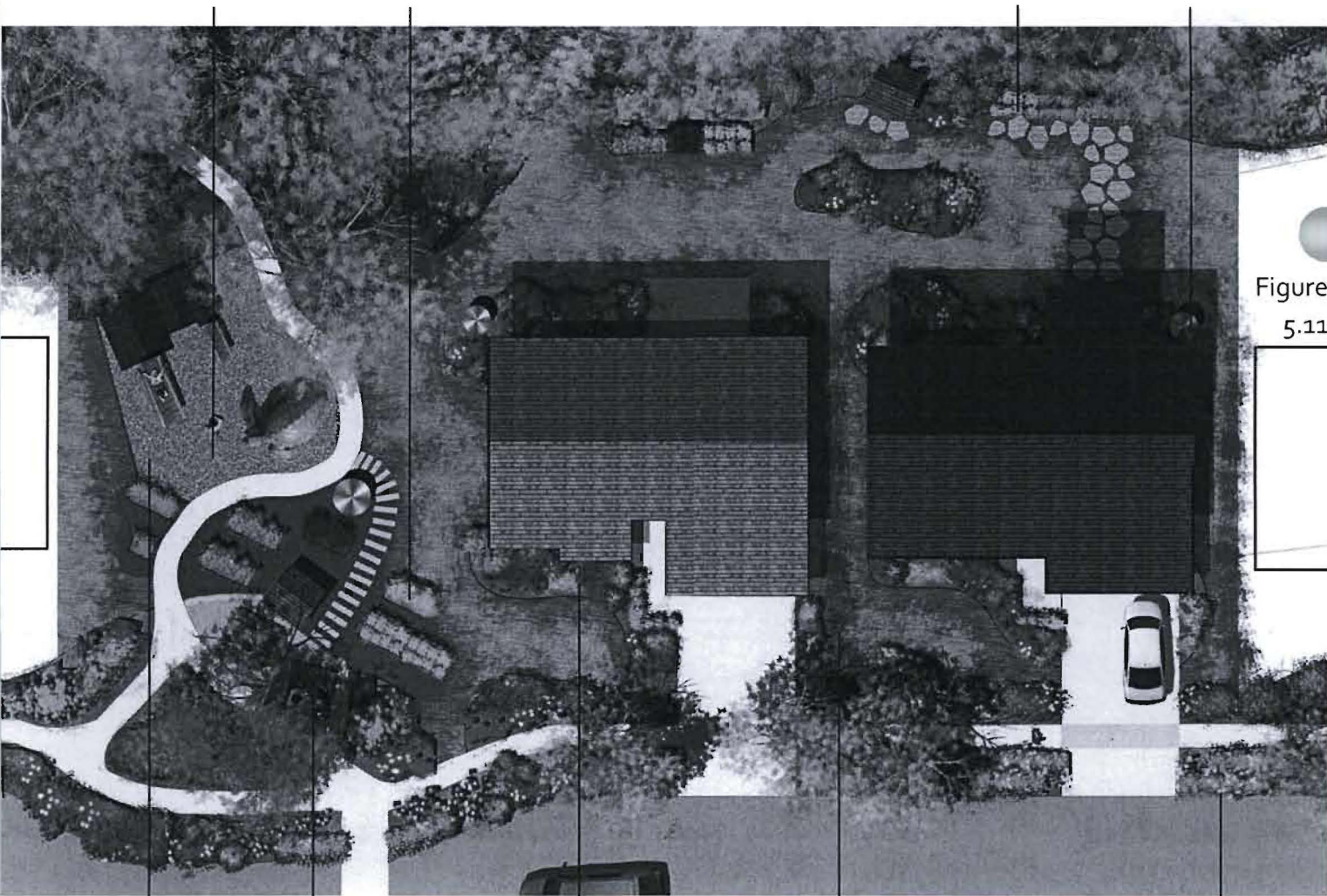
# 3 21ST CENTURY NEIGHBORHOOD PLAN

5' WIDE WOODLAND  
PATH FROM 50s-70s  
NEIGHBORHOOD

COMMUNITY GARDEN  
WITH CISTERN

VEGETABLE PLANTING  
BEDS (VARIED WIDTHS)

RAINWATER  
CISTERN



PLAYGROUND  
WITH  
SLIDES  
AND TURTLE

GAME AREA  
WITH PICNIC  
TABLES

VEGETABLES  
AMONG  
NATIVE  
VEGETATION

SHALLOW  
SWALE

10' WIDE SWALE  
ALONG STREET

0' 10' 20' 40' 80'



Figure  
5.11

## PARK, PATH, AND HOMES

Figure 5.12 illustrates how the park and woodland path fit within the small space once occupied by a home. A natural drainage system and more native vegetation around the site filter stormwater. Community and private vegetable beds provide food for residents, and vegetable plantings may remain relatively unobtrusive when mixed with ornamental vegetation in resident's front yards.

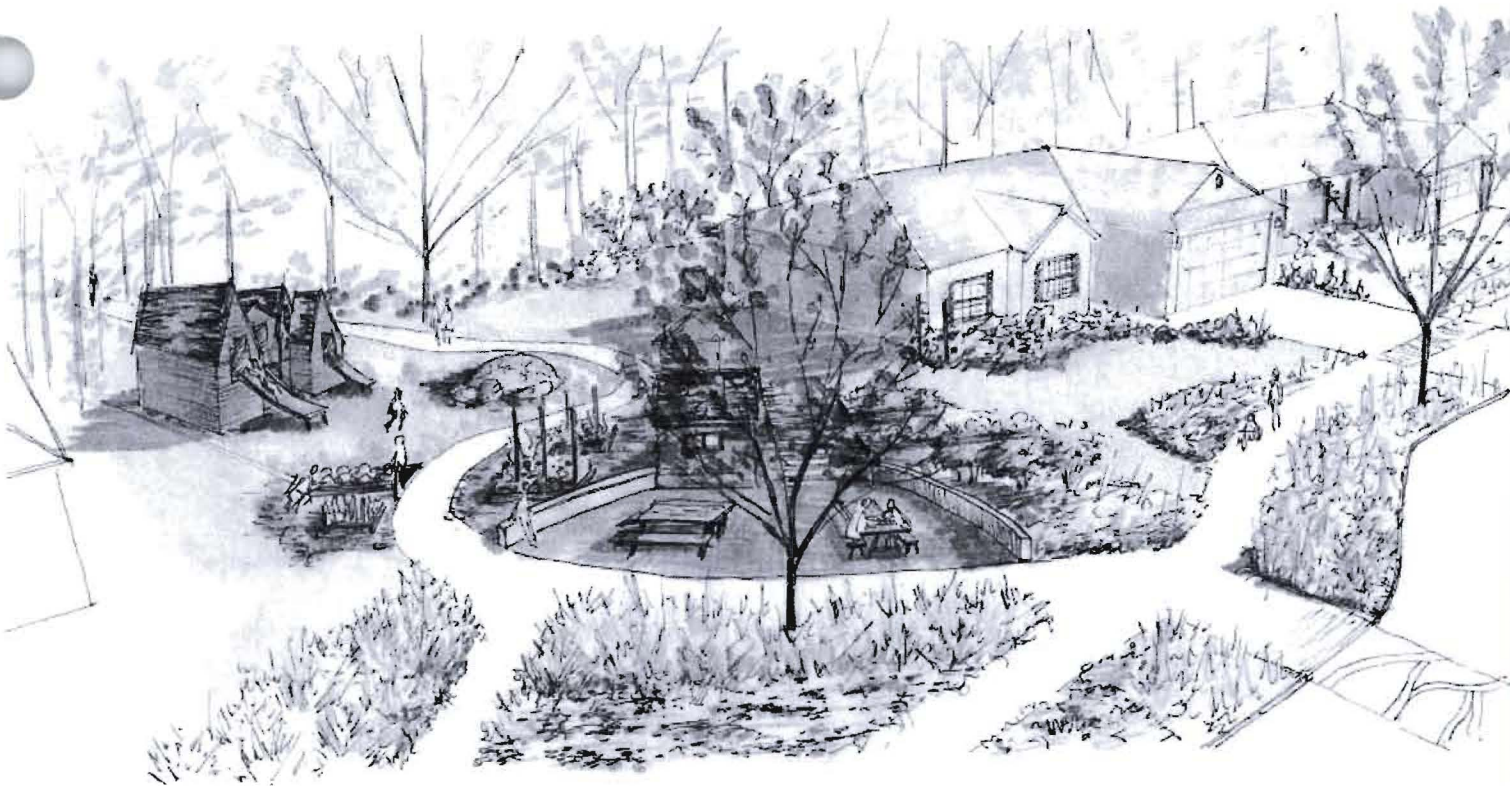


Figure 5.12: Axon of the Park as It Relates to the Homes



# 1 COMMERCIAL PLAZA AREA PROGRAM & DETAIL CONCEPT

At the center of the axis created by the Mariner Drive boulevard and north/south pedestrian path lies the main plaza. This space may be used for both public and private seating and community events. To that end I applied the following programmatic elements to the plaza site.

- Construct **vegetable beds** near structures for use by restaurant, other businesses, and passersby
- Include **cafe tables** and **planters** for use by customers and visitors and to create different enclosures
- Use **native vegetation** within planters around plaza
- Locate **natural drainage system features** (swales, stormwater planters) towards road
- Use **structures** and **paving materials** to pull visitors along N/S axis, into and out of commercial area



Figure 5.14: The Current Site Lacking Structures

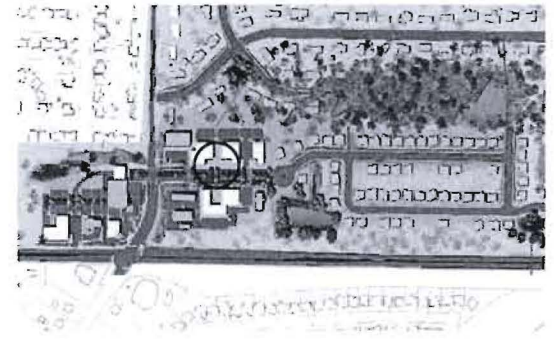


Figure 5.13: Commercial Plaza Site  
Design Location



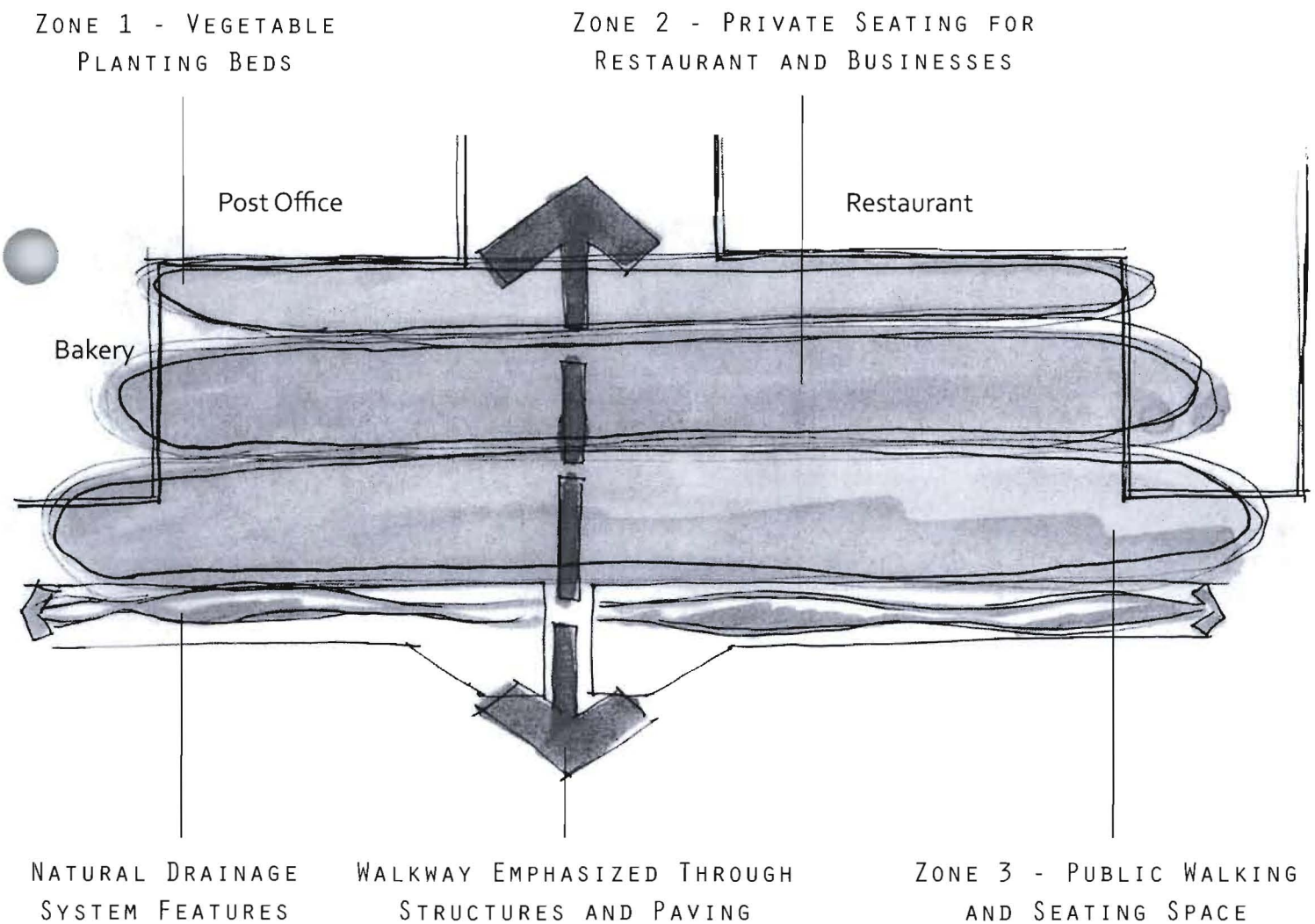


Figure 5.15: Design Concept Plan

# 1 PLAZA AREA PLAN



Figure 5.16: Plaza Area Plan





VEGETABLE PLANTING  
BEDS OF VARYING SIZES

CONCRETE PAVEMENT INSPIRED  
BY PRAIRIE GRASSES

BENCHES ATTACHED TO CONCRETE  
PLANTERS WITH GRASSES AND  
NATIVE VEGETATION

8' WIDE, 18' LONG  
STORMWATER PLANTERS

ON-STREET PARKING WITH  
PERMEABLE PAVERS

Figure 5.16, the Plaza Area Plan, details how private and public space interact. Cafe seating serves the bakery and restaurant while planters with benches provide much seating for everyone. The planters also delineate space, providing different kinds of experiences for visitors. Stormwater planters near the street capture runoff from both the plaza and road. Finally, I was inspired by the prairie grasses grown on the green roof of Oaklyn Library and imitated the grass pattern within the colorful pavement near the center of the site. Native vegetation dominates the plantings here, of course.



# 1 FROM PLAZA TO STREET

Figure 5.17 clarifies how the planters appear in relation to the rest of the plaza, the honeylocust trees, the sidewalk, and the street. Much seating space exists along with room for setting up displays and tables as part of events. As the site is so expansive, I was also able to include large stormwater planters to infiltrate runoff near the street.

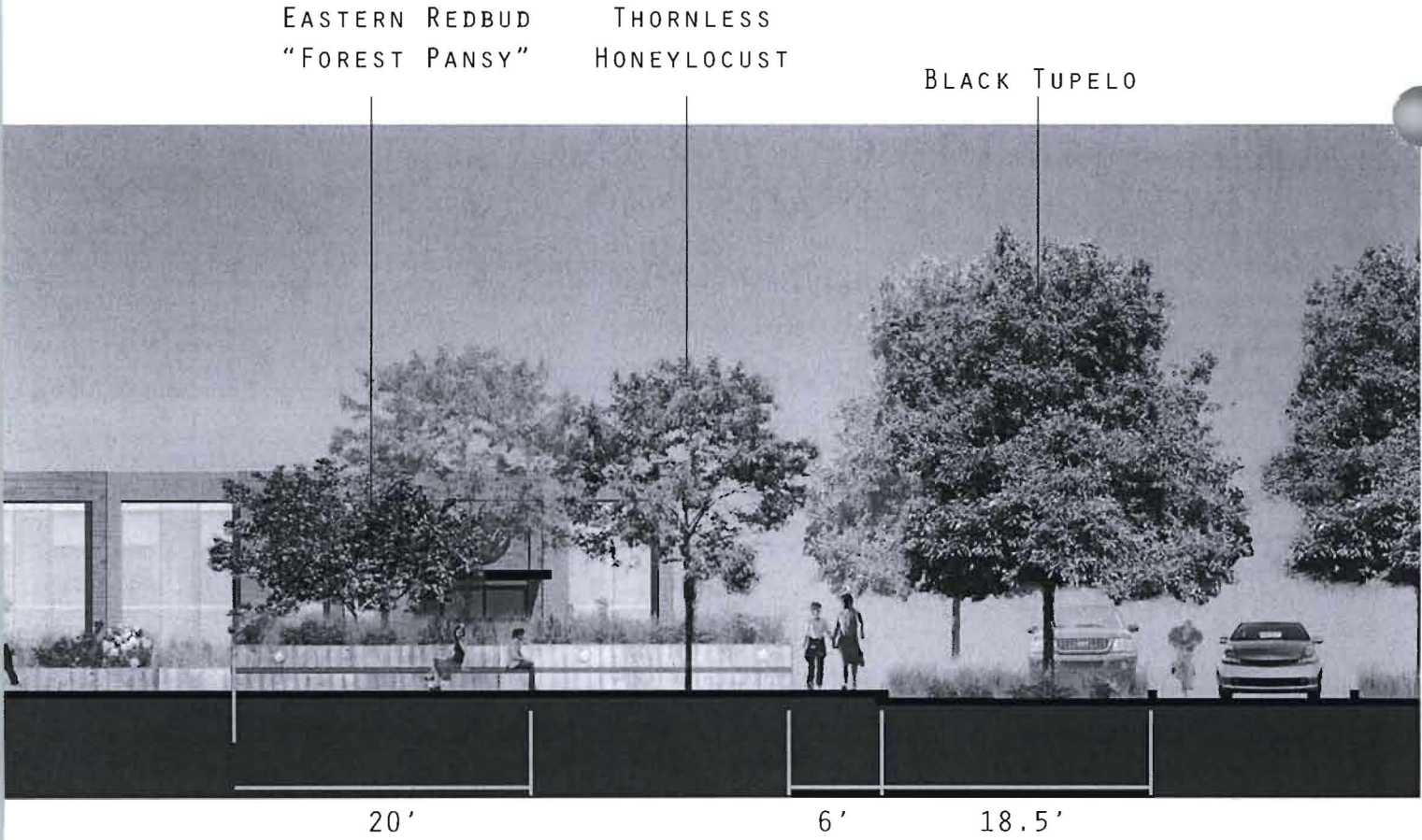
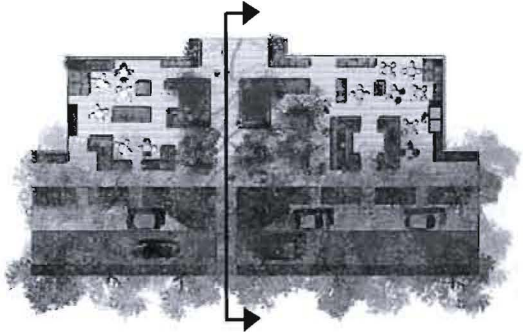
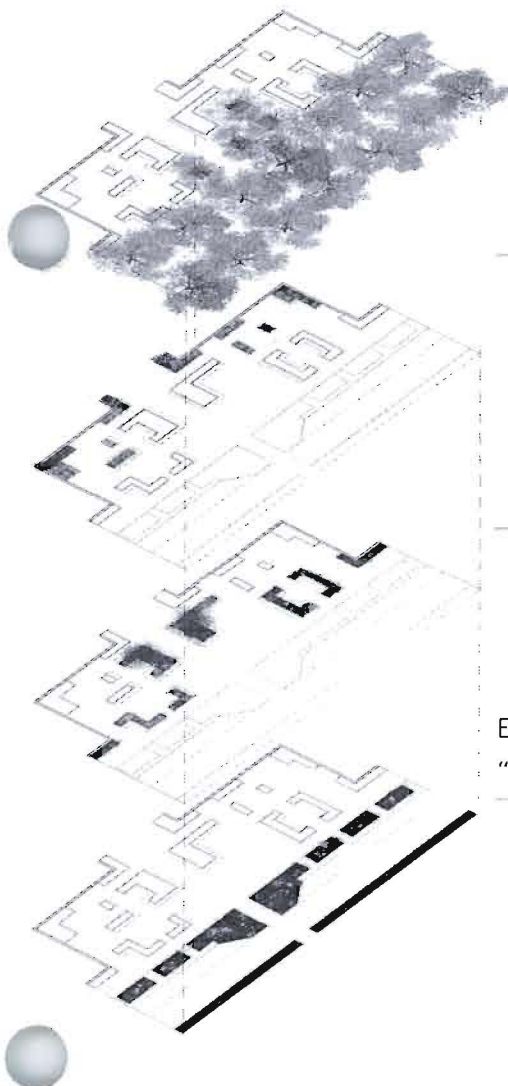


Figure 5.17: Major Plants and Design Element Widths from Plaza to Street



## VEGETATION

Figure 5.18 gives a small sampling of the plants that could be included in different areas of the site. I also included illustrations of how the tall trees would look in autumn.



BLACK  
TUPELO



BLACK TUPELO  
IN AUTUMN



THORNLESS  
HONEYLOCUST



HONEYLOCUST  
IN AUTUMN



BEET



GREEN  
PEPPER



BASIL



ROSEMARY



EASTERN REDBUD  
"FOREST PANSY"



CARDINAL  
FLOWER



LITTLE  
BLUESTEM



FALSE  
SUNFLOWER



SWAMP  
MILKWEED



COMMON  
SNEEZEWEED



INDIAN  
GRASS



WHITE  
TURTLEHEAD

Figure 5.18: Plants for Different Areas of the Plaza

# 1 PLAZA CONSTRUCTION DETAILS

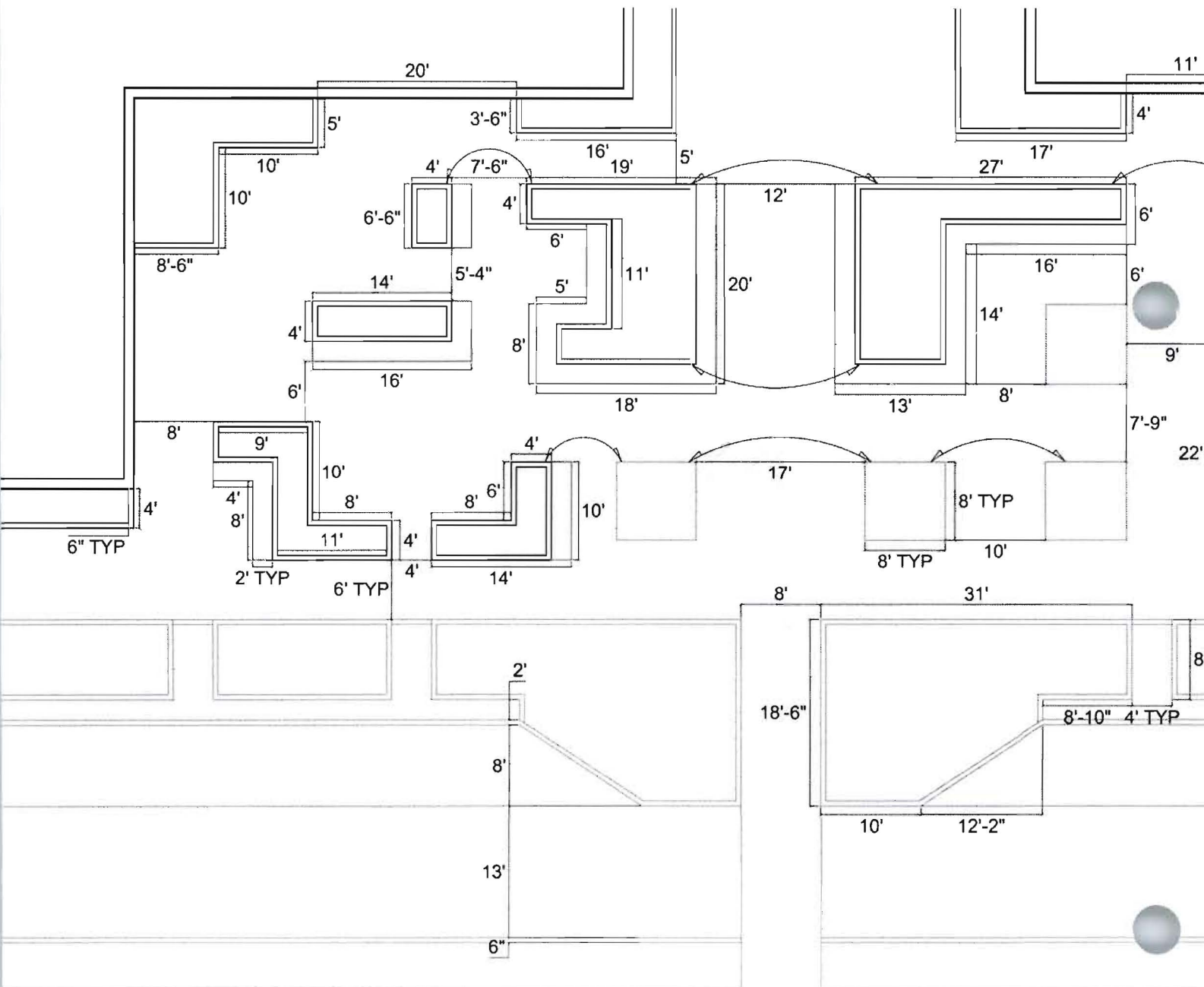
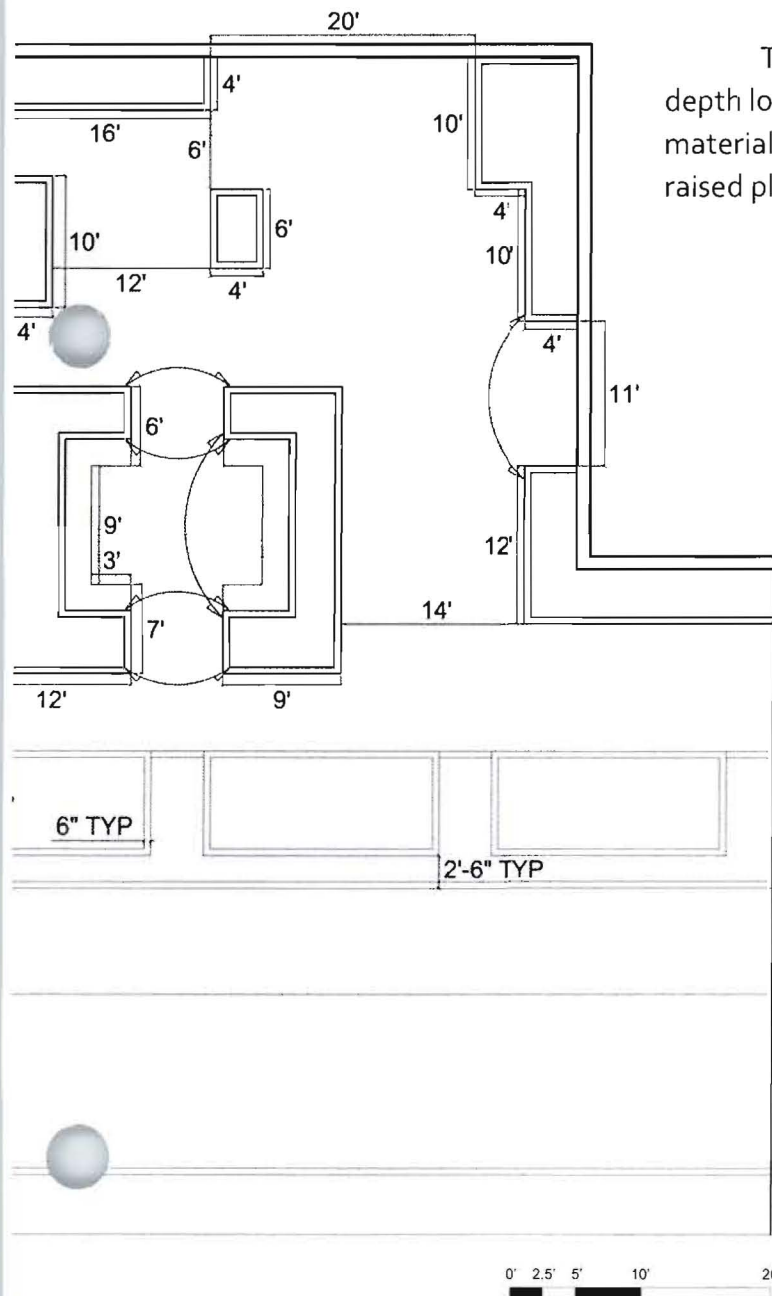


Figure 5.19: Layout Plan





The details between pages 57 & 61 provide a more in-depth look at how the plaza works. They illustrate specific sizes, materials, and features of different design elements, such as the raised planters and benches and colorful pavement pattern.

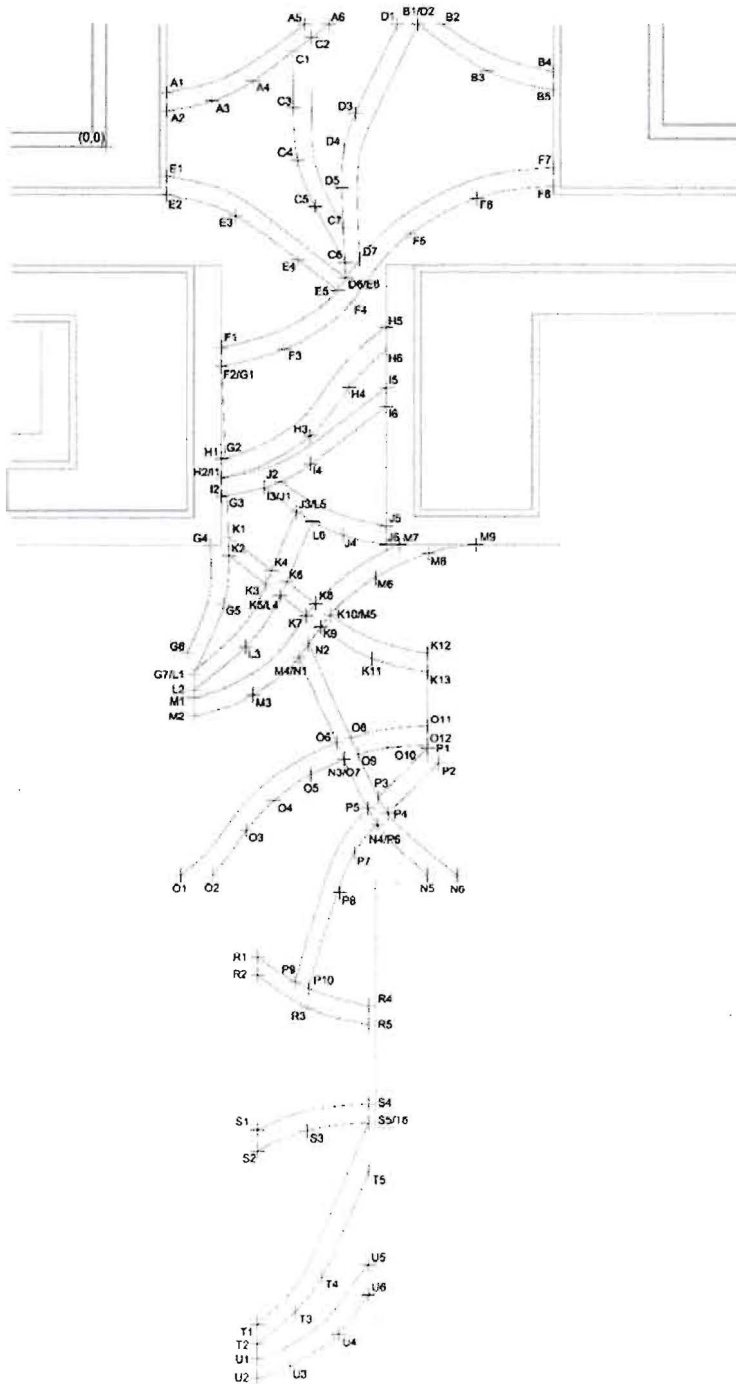


Figure 5.20:  
Pavement Layout Plan

<b>A - yellow</b>	<b>B - yellow</b>	<b>C - grey</b>	<b>D - grey</b>	<b>E - yellow</b>
A1 (4.3, 3.8)	B1 (22.5, 8.8)	C1 (13.4, 6.9)	D1 (21, 8.8)	E1 (4.4, -2.1)
A2 (4.3, 2.6)	B2 (24.3, 8.8)	C2 (14.8, 7.9)	D2 (22.5, 8.8)	E2 (4.4, -3.5)
A3 (7.6, 3.3)	B3 (27.4, 6.5)	C3 (13.5, 2.8)	D3 (18, 2.4)	E3 (9.3, -4.9)
A4 (10.6, 4.7)	B4 (32.2, 6.5)	C4 (13.8, -1)	D4 (17.2, -1.3)	E4 (13.8, -8.1)
A5 (14.3, 8.8)	B5 (32.2, 4.1)	C5 (15.1, -4.4)	D5 (17, -2.9)	E5 (16.7, -10.3)
A6 (16.1, 8.8)		C6 (17.3, -8.4)	D6 (17.3, -9.4)	E6 (17.3, -9.4)
		C7 (17.2, -5.8)	D7 (18.3, -8.1)	
<b>F - yellow</b>	<b>G - yellow</b>	<b>H - grey</b>	<b>I - yellow</b>	<b>J - yellow</b>
F1 (8.3, -14.4)	G1 (8.3, -15.7)	H1 (8.3, -21.4)	I1 (8.3, -23.7)	J1 (11.4, -24.4)
F2 (8.3, -15.7)	G2 (8.6, -21.3)	H2 (8.3, -23.7)	I2 (8.3, -25)	J2 (12.7, -23.9)
F3 (12.9, -14.4)	G3 (8.7, -24.9)	H3 (14.7, -20.7)	I3 (11.4, -24.4)	J3 (13.8, -26.1)
F4 (17.7, -11.2)	G4 (7.6, -28.5)	H4 (17.6, -17.2)	I4 (14.7, -22.7)	J4 (17.2, -27.8)
F5 (2.2, -6.3)	G5 (8.5, -32.7)	H5 (20.2, -12.9)	I5 (20.2, -17.2)	J5 (20.2, -27.2)
F6 (26.8, -3.7)	G6 (5.8, -36.3)	H6 (20.2, -14.5)	I6 (20.2, -18.5)	J6 (20.2, -28.4)
F7 (32.2, -1.5)	G7 (6.3, -37.3)			
F8 (32.2, -2.8)				
<b>K - grey</b>	<b>L - grey</b>	<b>M - grey</b>	<b>N - yellow</b>	<b>O - grey</b>
K1 (7.8, -27.9)	L1 (6.3, -37.3)	M1 (6.3, -39.4)	N1 (13.9, -36.5)	O1 (5.5, -52.4)
K2 (7.8, -29.3)	L2 (6.3, -38.9)	M2 (6.3, -40.8)	N2 (14.6, -35.6)	O2 (7.7, -52.4)
K3 (11.6, -31.4)	L3 (10.1, -35.7)	M3 (10.7, -39.2)	N3 (17.3, -44)	O3 (10.3, -49.1)
K4 (12, -30.3)	L4 (12.7, -32)	M4 (13.9, -36.5)	N4 (19.6, -48.7)	O4 (12.3, -47)
K5 (12.7, -32)	L5 (13.8, -26.1)	M5 (16.3, -33.5)	N5 (23.3, -52.4)	O5 (14.8, -48.1)
K6 (13.1, -31.2)	L6 (14.9, -26.7)	M6 (19.4, -30.8)	N6 (25.4, -52.4)	O6 (16.7, -48.1)
K7 (14.4, -33.6)		M7 (21.2, -28.4)		O7 (17.3, -44)
K8 (15.2, -32.7)		M8 (23.2, -29.1)		O8 (17.7, -42.5)
K9 (15.5, -34.4)		M9 (26.7, -28.4)		O9 (18.3, -43.6)
K10 (16.3, -33.5)				O10 (20.7, -43.2)
K11 (19.2, -36.6)				O11 (23.3, -41.6)
K12 (23.2, -36.3)				O12 (23.3, -43)
K13 (23.2, -37.5)				
<b>P - grey</b>	<b>R - yellow</b>	<b>S - yellow</b>	<b>T - grey</b>	<b>U - grey</b>
P1 (23.3, -43.2)	R1 (11, -58.2)	S1 (11, -70.4)	T1 (11, -84.3)	U1 (11, -86.7)
P2 (24, -44.3)	R2 (11, -59.5)	S2 (11, -71.9)	T2 (11, -85.5)	U2 (11, -88)
P3 (19.6, -46.7)	R3 (14.7, -61.8)	S3 (14.6, -70.5)	T3 (13.7, -83.3)	U3 (13.4, -87.3)
P4 (20.4, -47.9)	R4 (19, -61.6)	S4 (19, -68.5)	T4 (15.7, -80.8)	U4 (16.8, -85)
P5 (19, -47.5)	R5 (19, -63)	S5 (19, -70)	T5 (19, -73.4)	U5 (19, -80)
P6 (19.6, -48.7)			T6 (19, -70)	U6 (19, -82.2)
P7 (18, -50.8)				
P8 (16.9, -53.5)				
P9 (13.7, -60)				
P10 (14.6, -60.5)				

Figure 5.21: Pavement Layout Coordinates

0' 2.5' 5' 10' 20'



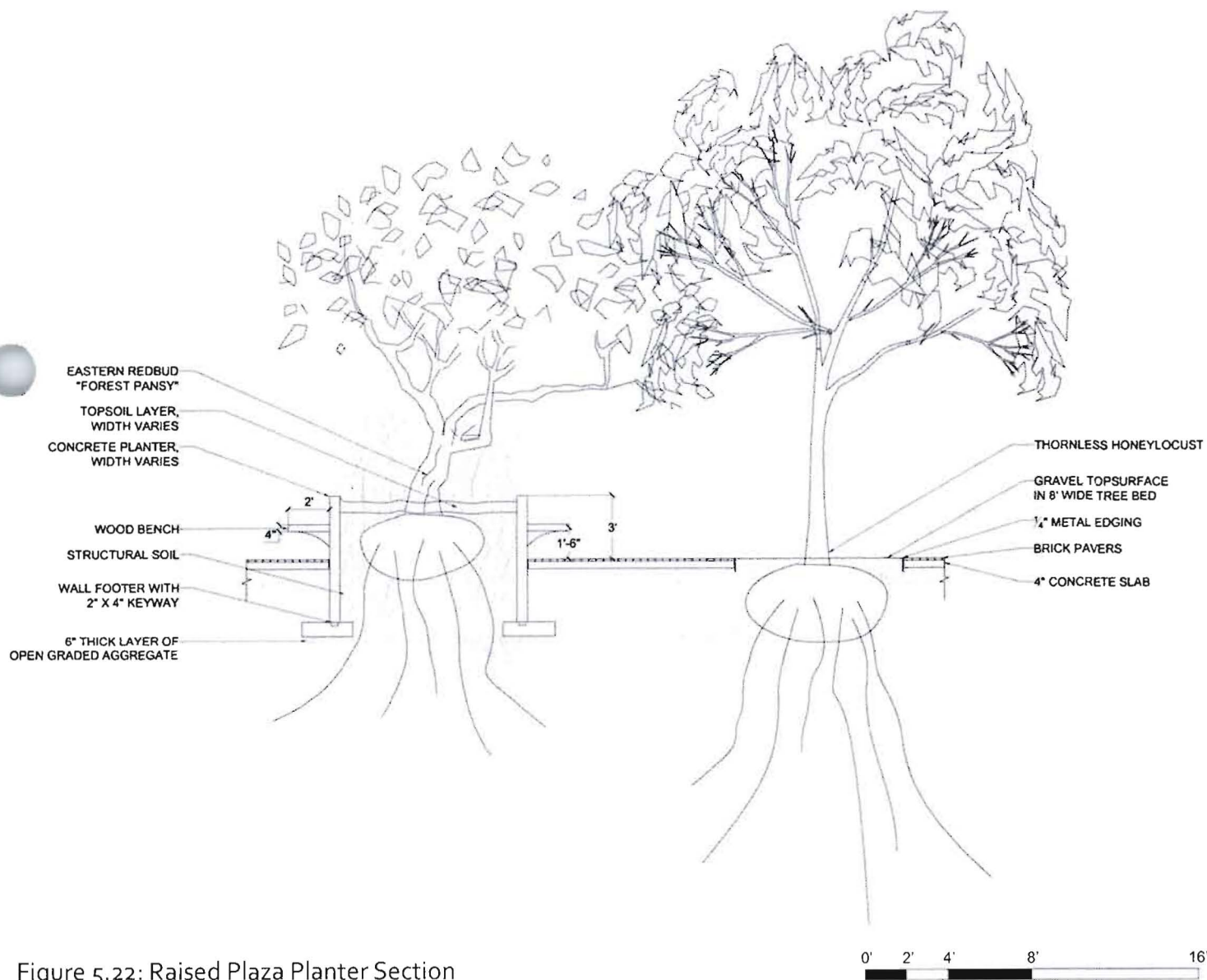
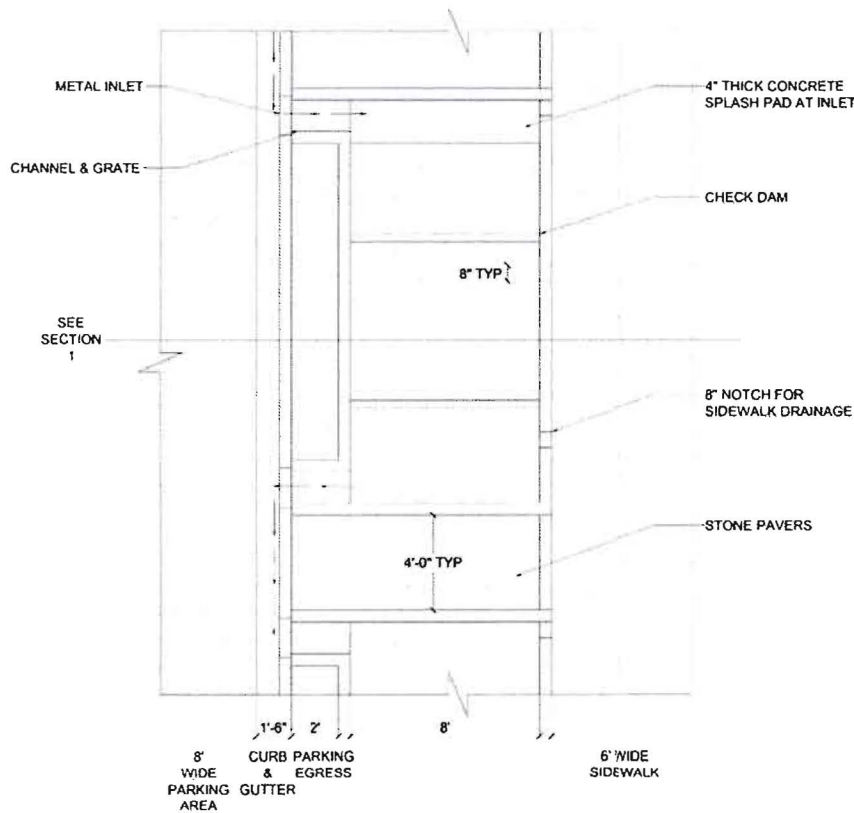
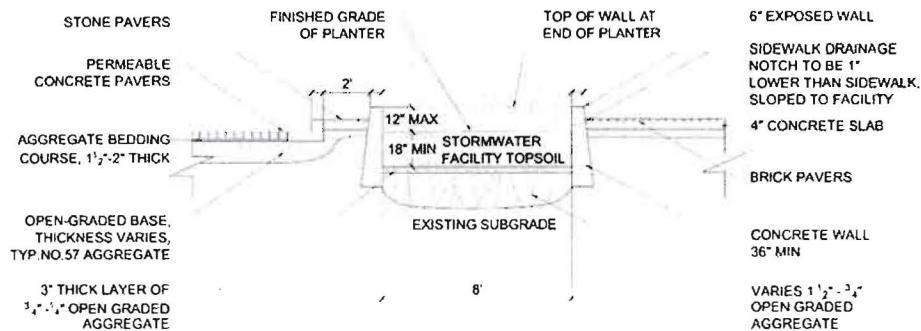


Figure 5.22: Raised Plaza Planter Section





PLANTER PLAN



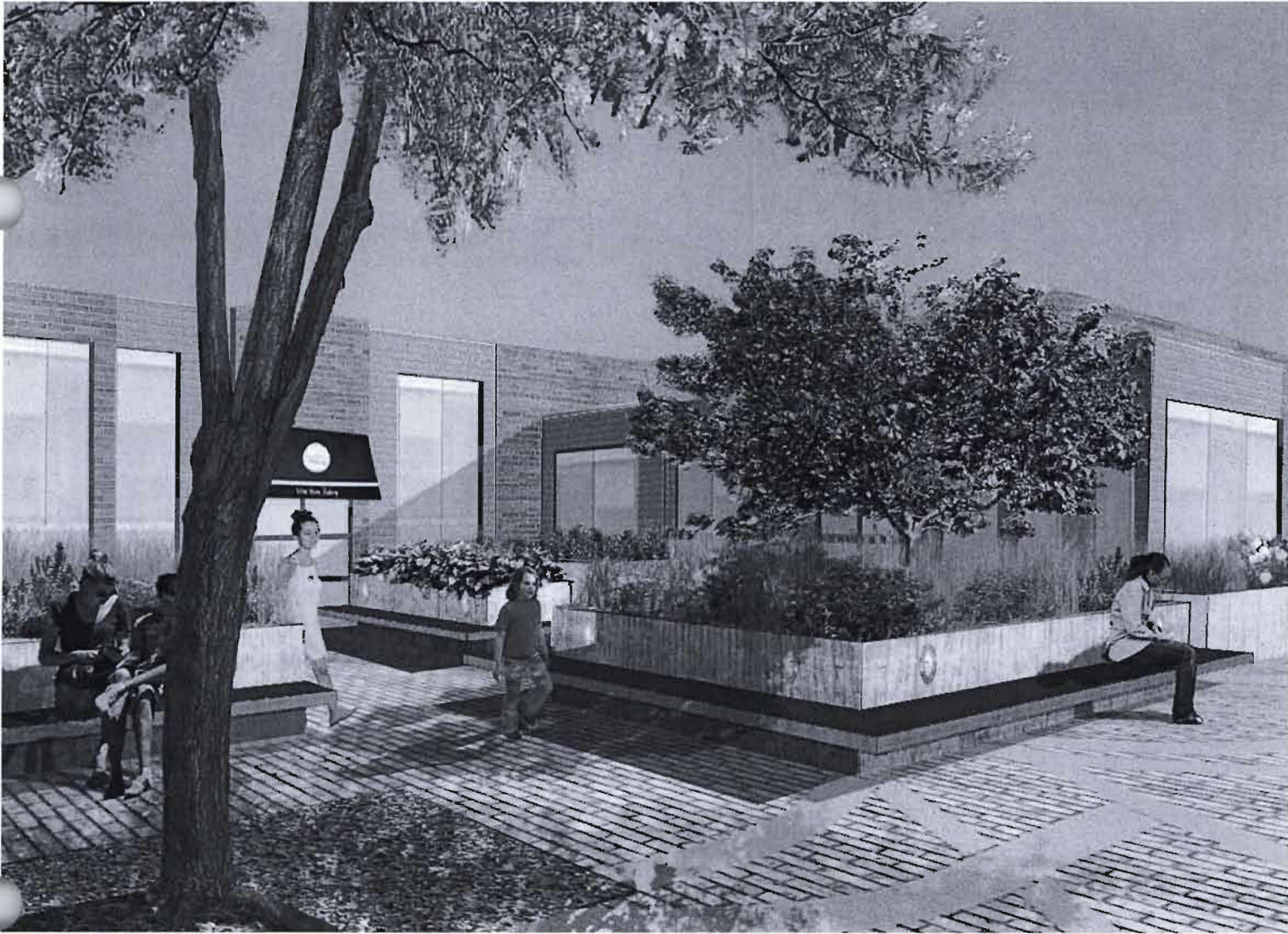
SECTION 1

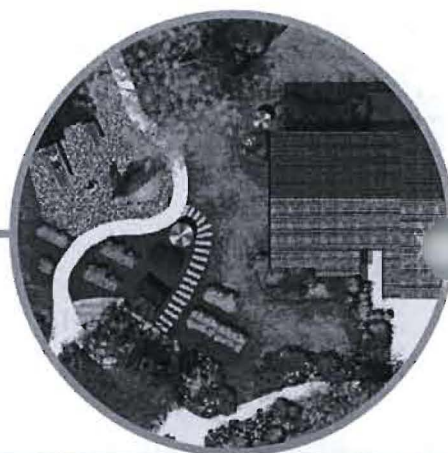
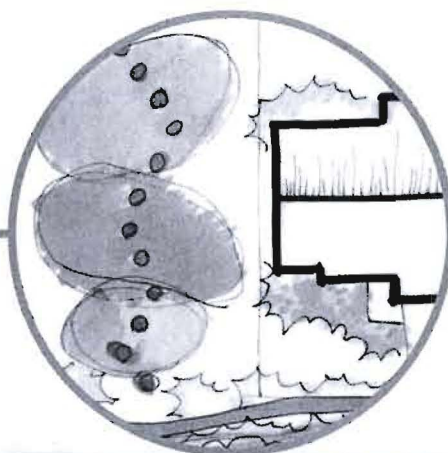


Figure 5.23: On-Street Stormwater Planter Plan & Section

## LOOKING WEST

Figure 5.24 illustrates how the planters, benches, prairie-inspired pavement, vegetation, and structures all mix to form a comfortable and cohesive space.





CONCLUSION



With this project I sought to shape a more holistic and sustainable suburban community. The large area framework plan, focus area master plan, and site designs all illustrate how the transformation occurred at different scales and in different contexts — commercial versus residential, for instance. Following the project goals I incorporated multi-modal transportation, increased recreational opportunities and spaces, and protected natural features throughout the differently-scaled designs.

Of course, time constraints restricted the breadth of my exploration. An expanded project might include more extensive research into social needs and desires within suburbs, what makes commercial areas successful, what kinds of vegetation and how many plants would be appropriate for restaurant and home planting beds, etc. This particular project might have been strengthened by additional illustrations of commercial area aesthetics and construction drawings detailing sustainable infrastructure function. However, I did try to present an adequate amount of work to comprehensively illustrate the aesthetics and function of my design intentions.

Like rural and urban environments, the suburbs support people's living needs and desires. However, as research today elucidates the negative environmental and human health impacts of suburbia, both subtle and dramatic improvements might be made through planning and design to increase suburbs' sustainability. As this project largely dealt with subtle improvements, I provided a list clarifying project benefits on the next two pages of this document. With this project I hope to have contributed to the formation of a more beautiful, healthy, and sustainable suburb.

## PROJECT BENEFITS

CATEGORY/LOCATION	RETROFIT ACTION	BENEFIT
FRAMEWORK PLAN	Location of project within existing community and around existing commercial area	<ul style="list-style-type: none"> <li>-Reduces impact on undeveloped land and ecological systems</li> <li>-Reduces motor vehicle and fuel use and necessary road infrastructure</li> </ul>
	Maintenance of existing homes and commercial buildings	Reduces natural and financial resources needed for construction and maintenance of new infrastructure
	Protection and enhancement of ecological corridor and water bodies	<ul style="list-style-type: none"> <li>-Maintains animal and plant biodiversity</li> <li>-Provides natural filter of air and water pollutants and minimizes impact on quality of local water bodies such as Pigeon Creek and the Ohio River</li> </ul>
	Development of diverse uses/ spaces in neighborhoods and commercial area	<ul style="list-style-type: none"> <li>-Encourages walking and bicycling to nearby attractions, reducing motor vehicle and fuel use</li> <li>-Promotes interaction among people from different neighborhoods</li> <li>-Provides jobs for local residents</li> </ul>
	Formation of recreation path network on neighborhood streets and off-road trails	<ul style="list-style-type: none"> <li>-Encourages walking and bicycling and other physical activity</li> <li>-Provides opportunities for safe exploration of neighborhoods and natural areas</li> </ul>
505 - 705 NEIGHBORHOOD	Planting of native vegetation on steep slopes and around homes	<ul style="list-style-type: none"> <li>-Minimizes erosion and reduces runoff into water bodies</li> <li>-Minimizes yard space to mow, reducing fuel consumption</li> <li>-Provides habitat for insects and small animals</li> </ul>
	Inclusion of bio-retention features such as swales and rain gardens	<ul style="list-style-type: none"> <li>-Reduces runoff into water bodies</li> <li>-Minimizes negative impact on quality of local water bodies</li> <li>-Provides habitat for insects and small animals</li> </ul>

CATEGORY/LOCATION	RETROFIT ACTION	BENEFIT
50s - 70s NEIGHBORHOOD	Narrowing of road	<ul style="list-style-type: none"> <li>-Reduces impervious surface and runoff by increasing water infiltration</li> <li>-Reduces driving speeds, making streets safer</li> </ul>
	Integration of sidewalks and off-road connection to commercial area	<ul style="list-style-type: none"> <li>-Creates a comfortable pedestrian environment, encouraging physical activity</li> <li>-Reduces motor vehicle and fuel use</li> </ul>
	Development of neighborhood park	<ul style="list-style-type: none"> <li>-Encourages physical activity and public health</li> <li>-Promotes connection with nature and enhances animal habitat</li> <li>-Promotes interaction with neighbors, strengthening community ties</li> </ul>
	Inclusion of home vegetable gardens	<ul style="list-style-type: none"> <li>-Encourages consumption of local food, minimizing resources needed to ship food</li> <li>-Encourages physical activity</li> </ul>
21st CENTURY NEIGHBORHOOD	Inclusion of bio-retention features such as swales and rain gardens	<ul style="list-style-type: none"> <li>-Reduces runoff into water bodies</li> <li>-Minimizes negative impact on quality of local water bodies</li> <li>-Provides habitat for insects and small animals</li> </ul>
	Narrowing of road	<ul style="list-style-type: none"> <li>-Reduces impervious surface and runoff by increasing water infiltration</li> <li>-Reduces driving speeds, making streets safer</li> </ul>
	Inclusion of sidewalks	<ul style="list-style-type: none"> <li>-Creates a comfortable pedestrian environment, encouraging physical activity</li> <li>-Reduces motor vehicle and fuel use</li> </ul>
	Development of neighborhood park	<ul style="list-style-type: none"> <li>-Encourages physical activity</li> <li>-Promotes connection with nature and enhances animal habitat</li> <li>-Provides access to wooded area</li> <li>-Promotes interaction with neighbors, strengthening community ties</li> </ul>



CATEGORY/LOCATION	RETROFIT ACTION	BENEFIT
21st CENTURY NEIGHBORHOOD	Inclusion of home vegetable gardens	-Encourages consumption of local food, minimizing resources needed to ship food -Encourages physical activity and public health
COMMERCIAL AREA	Provision of public space, such as the plaza	-Promotes group gathering and interaction between residents of different neighborhoods and communities -Provides space for social/cultural events
	Location of parking on street and towards sides and behind buildings	-Reduces visibility of motor vehicles, enhancing pedestrian environment and promoting area walkability while still providing vehicular access
	Inclusion of wide sidewalks within boulevard	-Enhances pedestrian comfort and area walkability -Reduces vehicle and fuel use
	Provision of space for bicyclists within driving lanes	-Promotes physical activity -Reduces vehicle and fuel use
	Inclusion of bio-retention features within boulevard	-Reduces runoff -Supports improved water quality
	Development of urban agriculture plots	-Encourages consumption of local food, minimizing resources needed to ship food
	Increase in building density	-Reduces necessity for sprawl -Makes numerous services available within a short distance

# APPENDICES

## APPENDIX A: DEFINITION OF TERMS

**Bikeable:** a concept of communities, neighborhoods, cities etc. where goods, services, and public open/recreational space may be easily accessed by bicycle

**Community:** a group of people who share common interests, values, culture, and/or social and lifestyle preferences

**Infrastructure:** the technical features or facilities, such as roads, sewage systems, and power grids that help municipalities and communities function

**Multi-Modal Transportation:** transportation infrastructure that simultaneously supports personal and public motor vehicles, bicycles, and pedestrians

**Neighborhood:** a physical body of homes, businesses, and institutions that share common architectural, cultural, and/or economic characteristics

**Sustainability:** a concept of longevity and lasting efficiency in all things – products, infrastructure, communities, etc.

**Sustainable Infrastructure:** a type of infrastructure that is long lasting, efficient, and less wasteful than conventional infrastructure

**Walkable:** a concept of communities, neighborhoods, cities etc. where goods, services, and public open/recreational space may be easily accessed on foot



## APPENDIX B: DESIGN CONSIDERATIONS

Major elements impacting the design included:

**Arterial Roads:** Oak Hill and Lynch Roads carry heavy traffic and may be considered gateways into the area. The views from them, modes of transportation along them, and areas where they might be crossed affected the look and function of my design.

**Woodlands and Pigeon Creek:** Woodlands and Pigeon Creek weave through the site. Their preservation was of central importance in protecting the site's heritage, maintaining wildlife habitat, and providing recreational opportunities for residents.

**Existing Services:** Commercial services, such as a CVS, are located at the intersection of Oak Hill and Lynch. I considered whether to preserve existing structures or redevelop the commercial area entirely. After deciding to preserve the existing structures I explored how new structures might be integrated with the old, and I tested different concepts for making the area walkable and sustainable.

**Residences:** With the site focus area I considered the landscape surrounding older (1950s - 70s constructed) and younger constructed after 2000) homes. Varying lot sizes and topography affected my sustainable infrastructure designs.

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## APPENDIX D: IMAGE SOURCES (I provided all other unnumbered images.)

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